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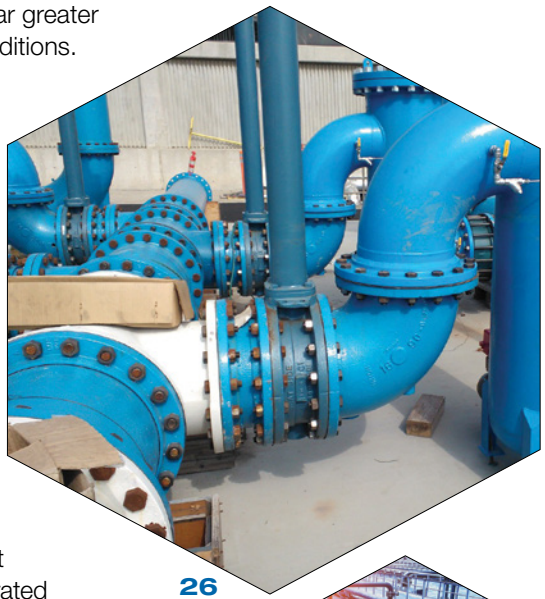
Cover Story



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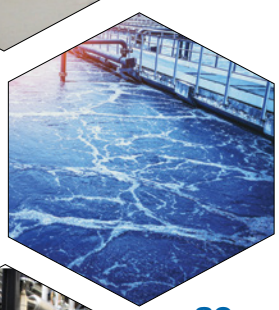

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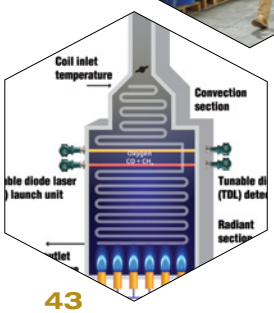

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Editor's Page

Utilizing carbon dioxide

Reducing carbon dioxide emissions has taken center stage in efforts to reduce concentrations of greenhouse gases in the environment. Much effort is going into limiting the use of fossil fuels through increased use of renewable energy sources, switching to alternate feedstocks for industrial processes and developing more efficient processes. While these changes are underway — some more quickly than others — carbon-based products are, and will continue to be, needed for the foreseeable future. Carbon capture and utilization is therefore poised to play an important role in CO_2 emissions reduction.

Opportunities for carbon utilization

A new report released in August by the National Academies of Sciences, Engineering and Medicine [*1*] examines opportunities for CO_2 utilization, current technologies, research and development needs, and related policies and infrastructure. Included in the report is also an assessment of how coal waste might be utilized to produce critical minerals and carbon-based materials — particularly long-lived products, such as concrete and other construction materials.

The congressionally mandated report, sponsored by the U.S. Dept. of Energy (DOE; www.energy.gov) presents a research agenda identifying opportunities for CO_2 utilization including: mineralization of CO_2 into inorganic carbonates; conversion of CO_2 into elemental carbon materials; and chemical and biological pathways for CO_2 conversion into organic chemicals and fuels. Highlighted research areas include catalyst optimization, machine-learning techniques, improved reactor design and more. The report offers a number of recommendations for the DOE, for example to prioritize research on co-located carbon capture and conversion.

Government funding support

In mid-August, The DOE's Office of Fossil Energy and Carbon Management (FECM) announced additional funding of up to $54.4 million to "support the development of technologies that capture CO_2 from industrial and power generation sources or directly from the atmosphere and transport it either for permanent geologic storage or conversion into valuable products such as fuels and chemicals." The funding announcement lists the following areas of interest that will be supported: reactive carbon capture approaches for point-source capture or atmospheric capture with integrated conversion to useful products; engineering-scale testing of transformational carbon capture technologies for natural-gas-combined-cycle (NGCC) power plants; engineering-scale testing of transformational carbon capture technologies in portable systems at industrial plants; preliminary front-end engineering design (pre-FEED) studies for carbon capture systems at existing NGCC power plants; pre-FEED studies for carbon capture systems at hydrogen production facilities using coal, mixed coal/biomass or natural gas feedstock; and enhancing CO_2 transport infrastructure.

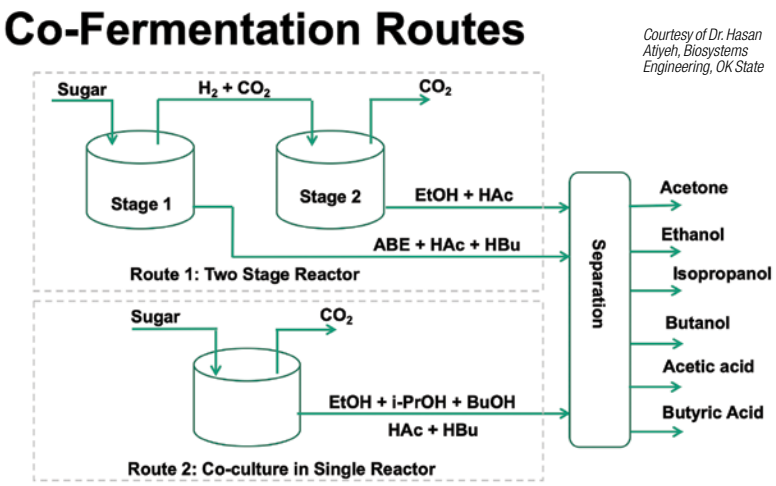
Another government program heavily investing in industrial decarbonization projects is the Industrial Demonstrations Program (IDP) that is administered by the DOE's Office of Clean Energy Demonstrations (OCED). For more on this, see Public-Private Partnerships Spur Decarbonization Efforts, *Chem. Eng.*, August, 2024, pp. 12–16. ■

Dorothy Lozowski, Editorial Director

1.National Academies of Sciences, Engineering, and Medicine. Carbon Utilization Infrastructure, Markets, and Research and Development: A Final Report. Washington, DC: The National Academies Press, 2024. https://doi.org/10.17226/27732

Biofuels production via co-fermentation of sugar and CO_2 takes a step forward

Co-fermentation processes that can consume both sugars and CO_2 are emerging as a promising technology to enhance product yield and reduce emissions in biofuels production. A team of scientists at Oklahoma State University (Stillwater, Okla.; www.okstate.edu) are working to accelerate the large-scale adoption of co-fermentation processes and validate the use of industrially significant feedstocks. "Our co-fermentation method leverages advanced microbial engineering techniques, such as CRISPR-based gene editing, to create microbial strains that can tolerate inhibitory compounds present in biomass. By utilizing both sugars and CO_2, the co-fermentation process addresses key challenges in traditional fermentation processes, making it more efficient and sustainable for large-scale biofuel production," explains Hasan Atiyeh, Oklahoma State professor of biosystems and agricultural engineering.



ABE: acetone-butanol-ethanol; EtOH: ethanol; i-PrOH: isopropanol; BuOH: butanol; HAc: acetic acid; HBu: butyric acid.

To date, the team has demonstrated co-fermentation processes at liter-scale volumes. Since receiving a patent for a co-fermentation process in 2021, the team has integrated an *in-situ* separation process to recover butanol during the co-fermentation process and has also tested the ability of three new acetogens to convert CO_2 into C2 to C6 alcohols and fatty acids. "We have successfully conducted multiple trials to validate the process, achieving significant advancements in microbial-strain optimization, enzyme activity and product yields," says Atiyeh. The next steps will involve moving to the pilot scale and exploring partnerships with industry stakeholders to facilitate further scaleup.

One of the most significant breakthroughs in this work has been the validation of corn-steep liquor, a byproduct of corn milling, as a co-fermentation feedstock. "Corn-steep liquor is a cost-effective and renewable resource that provides essential nutrients that enhance microbial growth and biofuel production efficiency. Other promising feedstocks for co-fermentation in the industry include lignocellulosic biomass, such as switchgrass, agricultural residues and other organic waste materials. These feedstocks are abundant and can be sustainably sourced," adds Atiyeh.

There are currently no co-fermentation processes for sugar and gas running at an industrial scale specifically for biofuels production, but Atiyeh and his team hope to bridge the gap between research and industry with their work.

First industrial demonstration of plasma-based CO_2 conversion

Plasma technology is being explored as an avenue for many molecular conversions, such as methane reforming. Now, for the first time, a plasma-based CO_2-conversion technology is being demonstrated industrially. The proprietary technology, developed by D-CRBN (Antwerp, Belgium; www.d-crbn.com), is being trialed at a steel plant operated by ArcelorMittal S.A. (Luxembourg; www.arcelormittal.com) in Ghent, Belgium. "Our modular and scalable plasma technology is capable of splitting the CO_2 molecule into CO in a fully electrified, gaseous phase, without solvents or catalysts," explains David Ziegler, chief commercial officer and co-founder of D-CRBN.

At ArcelorMittal Ghent, CO_2 emissions from steelmaking are being collected by a carbon-capture unit operated by Mitsubishi Heavy Industries (MHI; Tokyo; www.mhi.com). The captured CO_2 is then fed to D-CRBN's system for conversion into CO, which can be fed back to the furnace as a reductant (replacing a portion of the coke or metallurgical coal used in the blast furnace). In other projects, the generated CO could also be used to produce value-added chemicals, such as fuels or organic acids.

The modular nature of the technology makes it both portable and highly scalable, and the plasma unit has a small footprint, meaning that the system can easily be placed at point-source locations. Furthermore, D-CRBN's process can work with a wide range of CO_2 concentrations, including streams with up to 50 vol.% nitrogen dilution, without impacting the efficiency of the conversion reaction. The ability to use dilute gas streams, notes Ziegler, greatly impacts the costs associated with upstream CO_2 capture and purification units.

This industrial pilot has a maximum conversion capacity of 1,000 ton/yr of CO_2. "By 2026, we aim to progress to our first commercial-scale unit, which will have capacity to convert 10,000 ton/yr of CO_2 in a mobile plug-and-play configuration," adds Ziegler.

Recycling process allows fast depolymerization of post-consumer mixed textiles

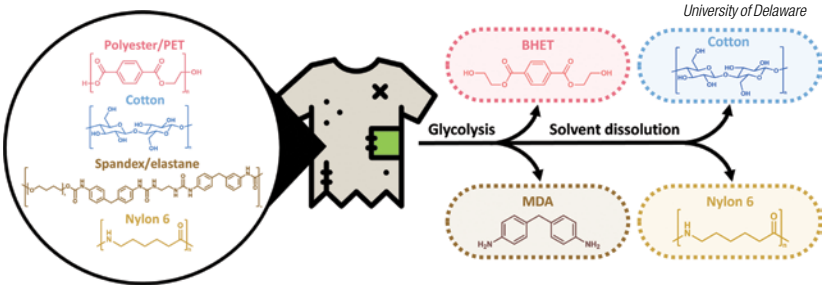
Recycling rates for post-consumer textile waste are very low (<0.5%) because the fabrics often consist of tightly interlaced synthetic and natural fibers that require costly sorting and separation processes, and because they often contain dyes and additives that must be addressed. A research team at the University of Delaware (UD; Newark, Del.; www.udel.edu), led by chemical engineering professor Dionisios Vlachos, has developed a method for recycling mixed fabrics made from blends of synthetic fibers, such as spandex, nylon and polyester, with natural fibers, such as cotton.

The process uses a microwave-assisted glycolysis reaction over a zinc-oxide catalyst, followed by solvent dissolution to depolymerize polyethylene terephthalate (PET) and spandex into their respective monomers, while leaving nylon and cotton intact. The approach makes mixed-textile recycling faster and more effective, potentially leading to high-quality recycled materials and greater circularity of the textile industry, the researchers say.

The UD process depends on the use of ethylene glycol (EG), a strong acceptor of microwave radiation, as a solvent. "The microwaves heat up the EG rapidly and help the glycolysis reactions to break down the synthetic fibers," explains UD graduate student Erha Andini, the first author of a paper published in a recent issue of the journal *Science* that describes the work.

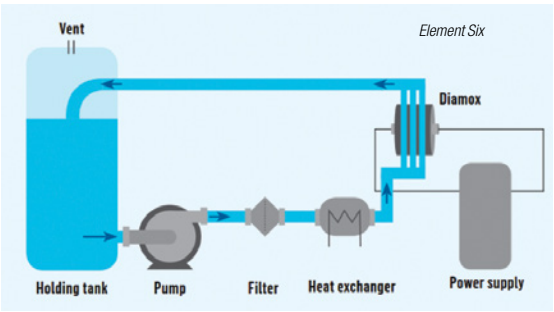
While the current project was demonstrated at the scale of grams, the team has carried out a techno-economic assessment of the process, and intends to scale it up to larger volumes of fibers. Further refinement of this process holds the potential to achieve a global textile circularity rate of 88%, the researchers wrote.

The effectiveness of the microwave-assisted glycolysis process in completely breaking down polyester and spandex while leaving cotton and nylon intact was surprising, Andini says, even successfully working on samples of unknown composition, she adds.



This integrated technology effectively destroys PFAS — even short-chain compounds

The prevalence of the various per- and polyfluoroalkyl substances (PFAS) — compounds that are notoriously difficult to break down — in the water supply is causing global concern. A new partnership between Element Six (Oxford, U.K.; www.e6.com) and Lummus Technology (Houston; www.lummustechnology.com) is tackling the PFAS challenge by combining Element Six's Diamox boron-doped diamond (BDD) electrochemical oxidation technology (for more, see *Chem. Eng.*, June 2016, p. 8) with Lummus' Zimpro Electro-Oxidation (ZEO) technology. One of the major challenges in PFAS treatment is in the destruction of short-chain PFAS compounds. "Our system can operate at two orders of magnitude higher current density than any other electro-oxidation technology on the market, allowing for a high capacity of destruction to take place in a small footprint. The high current densities enable the destruction of short-chain PFAS, where other electro-oxidation technologies may struggle. The technology delivered by this collaboration is the only field-deployable and scalable solution proven to destroy even short-chain PFAS," says Bruce Bolliger, head of business development, North America, for Element Six.



The ZEO system is a semi-batch process where liquid is sent to the system from a circulation tank. Once loaded, the PFAS concentrate is pumped across the BDD electrodes (where oxidation occurs), and then is returned to the circulation tank. In this way, long-chain PFAS compounds are broken apart to become either CO_2, NaF or fractionally smaller PFAS compounds. "This is where the technology sets itself apart from others, because it can efficiently break down the shorter PFAS where other technologies have struggled. The longer the process is operated, the more oxidation occurs and, eventually, only the smaller four- and five-carbon PFAS compounds remain. Then, to avoid moving into an electrically inefficient region, the partially oxidized PFAS mixture would be re-circulated to the front end of the PFAS separation process before complete oxidation is achieved. The already treated liquid would be combined with the PFAS going into the separation process for the first time, thus forming again a concentrated PFAS stream for electro-oxidation treatment," says Chad Felch, director of Zimpro Technology at Lummus. Because of this configuration, the ZEO system always sees a very concentrated PFAS input stream, which helps maximize efficiency.

Several pilot units for the integrated PFAS-destruction technology are operating at Lummus' research facility in Texas. "We can also bring our pilot units directly to customer locations, and we are currently initiating our first international pilot study in the U.K.," says Felch.

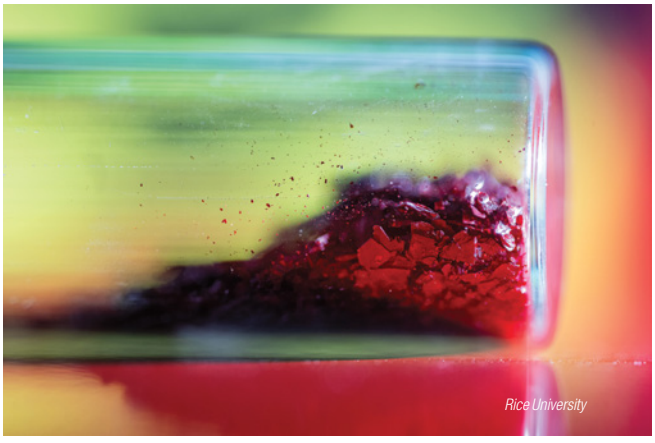
Two-dimensional template increases stability of perovskite photovoltaics

Using halide perovskites for photovoltaic (PV) solar-energy cells could dramatically reduce production costs compared to silicon-based PV cells, because perovskites are solution-processible at relatively low temperatures. However, long-term stability of these materials has been a significant challenge. Now, a research team at Rice University (Houston; www.rice.edu), has developed a method for synthesizing the perovskite formamidinium lead iodide ($FAPbI_3$) that imparts structural stability while also retaining high efficiency in converting solar energy to electricity.

As crystals of $FAPbI_3$ form from solution, the material can adopt multiple crystal structures: one, the so-called black phase, is highly photoactive, but not thermodynamically favored; another (yellow phase) has more structural stability, but is photoactively undesirable.

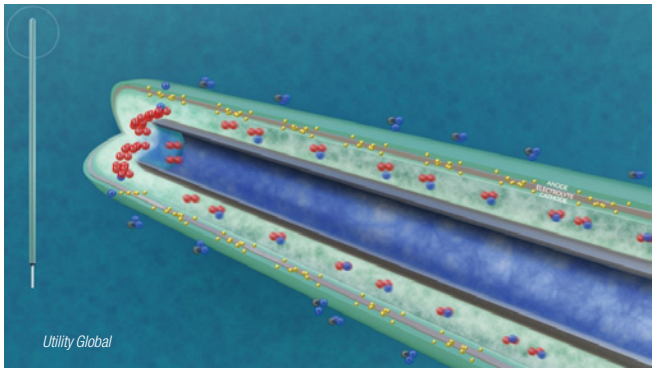
The Rice researchers have been working on ways to improve the quality and durability of the perovskite materials to move them closer to market readiness. In this project, they "seasoned" the precursor $FAPbI_3$ solution with specially designed two-dimensional perovskites (photo) that served as a stable structural template for the crystal lattice of the bulk material. The 2-D template kinetically "traps" the photoactive black phase as the material crystallizes, creating phase-pure films of $FAPbI_3$. Also, the 2-D "seed" template imparts compressive strain to the black phase, increasing its stability. The resulting $FAPbI_3$ films showed high (24.1%) power conversion efficiency, while also exhibiting what the researchers called "exceptional durability" — maintaining 97% of that efficiency for 1,000 hours at 85°C.

"Right now, we think that this is state of the art in terms of stability," says Rice engineering professor Aditya Mohite. "$FAPbI_3$ films templated with 2-D crystals were of higher quality, showing less internal disorder and exhibiting a stronger response to illumination, which translated as higher efficiency," explains Isaac Metcalf, a Rice graduate student and one of the first authors on the study, which was published in a recent issue of the journal *Science*.



This electrolysis reactor requires no external electricity source

Electrolyzers are the key technology for producing "green" hydrogen using renewable energy. However, a new reactor platform aims to facilitate electrolysis without the need for any external electricity. The Electroless Coupled Exchange Reduction Oxidation technology platform (eXERO), developed by Utility Global, Inc. (Houston; www.utilityglobal.com), removes the external electrical circuit from a traditional electrolyzer and instead drives the electrolysis reaction with the overpotential (voltage) that is present between different gas compositions being introduced at the system anode. This inherent overpotential facilitates the conversion of variable gas streams into hydrogen and synthesis gas (syngas) onsite. "Similar to a conventional solid-oxide electrolyzer, oxygen ions are transferred from the cathode to the anode through an ion-conducting electrolyte. However, unlike a conventional electrochemical reactor, electrons are transferred from the anode to the cathode through an electronically conducting phase within the electrolyte, also known as a mixed-conducting electrolyte," explains DeLome Fair, vice president of engineering at Utility Global. This counter-exchange of oxygen and electrons means that one gas stream is being reduced while the other is simultaneously oxidized, all without the application of any external current.



A key differentiator of eXERO is the ability to use a wide range of waste gases — even those that are dilute or variable in concentration — to drive the conversion reaction, and the ability to directly produce a high-purity product without any additional purification steps.

Utility Global, in partnership with the Colorado School of Mines (Golden; www.mines.edu), was recently granted funding from Colorado's Office of Economic Development to further develop and commercialize the eXERO platform. The proprietary ceramic reactor will be tested across a wide range of temperatures and pressures at the Colorado Fuel Cell Center. Utility Global is also field-testing eXERO technology with Canadian steelmaker Stelco at an integrated steelmaking site located in Nanticoke, Ontario. "This field demonstration will also validate that the reactor can process varying blast-furnace gas directly from an operating blast furnace and produce high-purity hydrogen," adds Fair, noting that eXERO can also handle waste-gas streams from steel processing, petroleum refining and biodigesters and landfills, as well as ammonia or CO_2.

Generalizable deep-learning technique for elucidating catalyst reaction mechanisms

Artificial intelligence techniques have great potential in generating insights into catalytic reaction mechanisms, opening the door to more selective and efficient catalysts. However, using machine-learning (ML) in a general way to study chemical reactions is challenging because broad approaches aimed at outlining all possible reaction pathways are impractical and algorithms that are mechanism-agnostic require human interpretation to connect features with phenomena. Now, a team of researchers led by Iowa State University (Ames, Iowa; www.iastate.edu) materials science professor Qi An has developed an ML framework to autonomously explore catalytic reaction pathways and mechanisms.

The technology is based on a type of ML called deep-reinforcement learning, which involves an ML agent "tasked with identifying plausible reaction pathways through interactions with a defined environment over time," the researchers write. "Instead of laboriously screening all potential reaction steps, reinforcement learning can navigate reaction networks in an automated manner," the team says.

The reinforcement learning (RL) framework has been termed high-throughput deep reinforcement learning with first principles (HDRL-FP). Principal investigator An explains: "The reaction-agnostic nature of HDRL-FP arises from its independence from the need for human experts to design specific RL representation of [the reaction] environment (for example states, actions or rewards) for a particular reaction. Instead, the RL environment is solely built on atomic positions, which are then mapped to the potential energy landscape derived from first principles."

This framework facilitates the fast running of thousands of concurrent RL simulations on a single graphics processing unit (GPU). With GPUs and high-throughput strategies, the method can quickly and automatically identify the optimal reaction pathway from thousands of potential pathways, An said, adding "That effectively identifies viable reaction mechanisms amidst the extremely noisy data in real chemical reactions."

"The excellent generalizability and cost-efficiency of our framework are primarily a result of the high-throughput capacity enabled by the pioneering architecture of HDRL-FP," An notes.

As a proof of principle, the team, which included collaborators from Salesforce AI research, used HDRL-FP to identify possible strategies to improve ammonia synthesis, where atmospheric nitrogen reacts with hydrogen over an iron catalyst via the Haber-Bosch process. The researchers anticipate their RL framework will be useful in studying a range of complex industrial catalytic reactions. They published results in a recent edition of *Nature Communications*.

Chementator Briefs

METHANE PYROLYSIS CATALYST

Catalytic methane pyrolysis (CMP) is an attractive route to producing hydrogen, because rather than generating CO_2, the process produces solid carbon, which can be made in valuable forms that could offset the cost of hydrogen production. However, finding effective catalysts for CMP have been a hurdle for this line of study.

Now, researchers at the National Energy Technology Laboratory (NETL; Pittsburgh, Pa.; netl.doe.gov) have scaled up hydrogen production tests using a CMP catalyst developed and patented by NETL. This summer, NETL researchers scaled up hydrogen production tests by increasing the catalyst load from 500 g to 4.5 kg, while observing high conversion rates and continuous H_2 production. The catalyst is also said to be lower cost than others reported in the literature, according to NETL.

"We achieved greater than 80% methane-to-hydrogen conversion for 30 hours in the test," said NETL's Ranjani Siriwardane. "And this was after using 10 times more catalyst than in the previous test, which shows that the material can be scaled up and work at the sub-pilot scale." "We've solved the problems facing other catalysts, such as poor conversion, high-cost and separation issues," Siriwardane adds.

RECYCLING WATER

In late June, Capture6 (Berkeley, Calif.; www.Capture6.org) broke ground for the Pure Water Antelope Valley (AV) Demonstration Facility that will house its new "Project Monarch" water-management and carbon-capture equipment. Capture6's process uses the brine that is a byproduct of the existing water treatment process to recover additional freshwater and extract mineralized carbonates. This process will eliminate the discharge of brine, while recovering clean water and removing carbon dioxide from the atmosphere.

Capture6 received a grant valued at over $8 million from the California Energy Commission under the Commercialization Industrial Decarbonization (CID) Program to help fund the project for the Palmdale Water District (PWD) facility. Additional funding was contributed by Elemental Excelerator, a nonprofit investor. Project Monarch is one of four facilities announced by Capture6. The facility is expected to be operational by 2026 with the plan of an expanded full-scale facility to be operational by 2030. For details of the technology, see "This process makes freshwater from brine while capturing CO_2," *Chem. Eng.* February 2024, p. 8.

PROPANE TO PROPYLENE CATALYST

Scientists from the U.S. Department of Energy's (DOE) Argonne National Laboratory (Lemont, Ill; www.anl.gov) and Ames National Laboratory (Ames, Iowa; www.ameslab.gov) have reported a faster, more energy-efficient way to manufacture propylene than the currently used process. A catalyst made from zirconium combined with silicon nitride was found to enhance the catalytic conversion of propane gas to propylene. The reaction was faster and catalytic conversion was achieved at a lower temperature than that typically required for traditional catalysts (842°F, compared to 1,022°F), the researchers say. The zirconium catalyst is also less expensive than precious metal catalysts like platinum. A paper on the study was published in the *Journal of the American Chemical Society*. Support for the research came from DOE's Office of Basic Energy Sciences, Division of Chemical Sciences, Geosciences and Biosciences, Catalysis Science program.

Business News

Plant Watch

Sika more than doubles capacity at its largest manufacturing plant in Indonesia

August 13, 2024 — Sika AG (Baar, Switzerland; www.sika.com) has more than doubled the production capacity at the Bekasi plant, its largest manufacturing facility in Indonesia. This site, which opened in 2019, specializes in the production of adhesives and grouts, as well as wall and facade systems. Sika has four mortar plants in Indonesia.

Invista completes nylon 6,6 capacity expansion in Shanghai

August 9, 2024 — Invista (Wichita, Kan.; www.invista.com) completed the expansion of its nylon 6,6 polymer site at the Shanghai Chemical Industry Park (SCIP). The site expansion, at a total investment of 1.75 billion RMB ($240 million), has doubled the annual capacity of nylon 6,6 polymer to 400,000 metric tons per year (m.t./yr). The expanded polymer site is fully integrated with existing Invista facilities, connecting upstream adiponitrile (ADN) and hexamethylene diamine (HMD) facilities.

Nippon Shokubai to construct new SAP plant in Indonesia

August 5, 2024 — Nippon Shokubai Ltd. (Tokyo; www.shokubai.co.jp) plans to build a 50,000-m.t./yr superabsorbent polymers (SAP) plant at its Indonesian subsidiary, PT. Nippon Shokubai Indonesia (NSI). This new plant will augment an existing SAP plant at NSI, which produces 90,000 m.t./yr currently. Mechanical completion of the new site is expected in January 2027, with commercial operations following in July 2027. The investment for the project is around $110 million. NSI also recently expanded its production facility for acrylic acid by 100,000 m.t/yr.

Verbio starts up ethanol production at biorefinery in Iowa

August 5, 2024 — Verbio SE (Leipzig, Germany; www.verbio.de) announced that its North American subsidiary has commenced the commercial production of corn-based ethanol at its biorefinery in Nevada, Iowa. Operating as a fully integrated biorefinery, Verbio has installed a total capacity to produce 60 million gal/yr of corn-based ethanol and 2.3 million MMbtu of renewable natural gas (RNG).

Lubrizol to invest $200 million to construct its largest plant in India

August 1, 2024 — Lubrizol Corp. (Cleveland, Ohio; www.lubrizol.com) announced plans to purchase a 120-acre plot in Aurangabad, India, where it intends to construct a new manufacturing facility to support the region's growing industrial-fluid markets. The initial phase of the project represents a projected investment of approximately $200 million, the company's largest ever in India. The plant will become the company's second-largest manufacturing facility globally and its largest manufacturing facility in India when completed.

Kemira expands sodium chlorate capacity in Brazil

July 29, 2024 — Kemira Oyj (Helsinki, Finland; www.kemira.com) announced an investment to expand the capacity of its sodium chlorate manufacturing facility in Ortigueira, Brazil. The investment, a strategic priority for Kemira's Pulp & Paper business, will enable Kemira to respond to the continued growth of the bleached-pulp market in South America, where Brazil is the leading producer in the region. The capacity increase of over 10% will be operational in the last quarter of 2024.

Enterprise to expand LPG terminal in Houston

July 30, 2024 — At the Enterprise Hydrocarbons Terminal (EHT) in the Houston Ship Channel, Enterprise Products Partners L.P. (Houston; www.enterpriseproducts.com) announced that it is adding refrigeration capacity that will increase propane and butane export volumes by approximately 300,000 barrels per day (bbl/d). In addition to providing incremental capacity for liquefied petroleum gas (LPG), the expansion will increase instantaneous loading rates for propane and butane, while making additional capacity available for propylene exports. The expanded service is expected to begin by the end of 2026.

Invista announces $17-million investment in HMD plant in Ontario

July 29, 2024 — Invista announced its intention to invest approximately $23 million CAD ($17 million USD) in the re-commissioning of hexamethylene diamine (HMD) assets at its Maitland, Ontario, Canada, site. Upon regulatory approval, the project construction will begin, with the HMD plant expected to start production in the first quarter of 2025. HMD is a key ingredient in the production of nylon 6,6.

Mergers & Acquisitions

Evonik and Knauer collaborating on scaleup of lipid nanoparticle formulations

August 13, 2024 — Evonik Industries AG (Essen, Germany; www.evonik.com) is collaborating with Knauer Wissenschaftliche Geräte GmbH (Berlin, Germany; www.knauer.net) to improve the scaleup of lipid nanoparticle (LNP) formulations. Evonik is a key supplier of lipids and LNP formulations to global pharmaceutical companies.

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Aramco acquires majority share in Petro Rabigh complex

August 8, 2024 — Aramco (Dhahran, Saudi Arabia; www.aramco.com) agreed to acquire an additional stake of approximately 22.5% in Rabigh Refining and Petrochemical Co. (Petro Rabigh), the refining and petrochemical complex located on Saudi Arabia's west coast, from Sumitomo Chemical Corp. (Tokyo; www.sumitomo-chem.co.jp) for $702 million. Aramco and Sumitomo Chemical currently each own a 37.5% stake in Petro Rabigh. Upon completion of the transaction, Aramco will become Petro Rabigh's largest shareholder, with approximately 60%, while Sumitomo Chemical will retain an equity stake of 15%.

Parker Hannifin divests composites manufacturing business

August 5, 2024 — Parker Hannifin Corp. (Cleveland, Ohio; www.parker.com) announced it has signed an agreement to divest its North America Composites and Fuel Containment (CFC) Division to private investment firm SK Capital Partners. Parker's CFC Division, a leading manufacturer of composites, fuel tanks and bladders, is headquartered in Erlanger, Ky. and has five additional locations across the U.S. and Mexico, with annual sales of approximately $350 million.

OCI Global to sell Texas ammonia project to Woodside

August 5, 2024 — OCI Global N.V. (Amsterdam, the Netherlands; www.oci-global.com) reached an agreement for the sale of 100% of its equity interests in its clean ammonia project under construction in Beaumont, Tex. to Woodside Energy Group Ltd. (Perth, Australia; www.woodside.com) for $2.35 billion. The ammonia project began construction in December 2022 and is expected to start production in 2025. It is designed for a production capacity of 1.1 million m.t./yr of ammonia in its first phase.

Veolia sells acid-regeneration business for $620 million

August 1, 2024 — Veolia S.A. (Paris; www.veolia.com) announced the divestment of Veolia North America Regeneration Services to private-equity firm American Industrial Partners (AIP) for an enterprise value of $620 million. Following AIP's acquisition of Veolia's Regeneration Services business, the acquired company has been renamed Nexpera. The acquired business unit includes Veolia North America's sulfuric-acid, potassium-hydroxide and hydrofluoric-acid regeneration activities for petroleum refineries, as well as sulfur-gas recovery and sulfur-based products activities.

Merck KGaA to sell Surface Solutions pigments business

July 29, 2024 — Merck KGaA (Darmstadt, Germany; www.emd.group.com) has agreed to sell its global Surface Solutions pigments business unit to Global New Material International Holdings (GNMI) Ltd. for €665 million. The Surface Solutions unit offers pigment solutions used in coating, industrial and cosmetic applications via its existing production facilities in Gernsheim, Germany, Onahama, Japan and Savannah, Georgia. ■

Mary Page Bailey

Taking Control of Chemical Dusts

Equipment innovations and monitoring solutions help chemical processors create more effective dust collection systems

Uncontrolled dust can lead to several complications, including health and safety concerns, product quality problems, regulatory compliance issues and legal ramifications. Although dust should not be ignored, many chemical processors struggle with dust control. Here, dust collection experts share their insight on how to remain compliant when developing dust collection systems, as well as the latest innovations and monitoring solutions designed to help chemical processors create dust collection systems that are more efficient and effective so they can maintain safe, cost-efficient, dust-free facilities.

Managing dust challenges

"Safety is the most important reason for proper dust collection," says Tara Brown, equipment project engineer with U.S. Air Filtration, Inc. (Tyler, Tex.; usairfiltration.com). "Processes that generate dust can create potential safety issues that should be taken seriously. Dust from chemical processing can cause serious health conditions, including respiratory, skin and eye issues."

Further, adds Chris Watson, general manager with U.S. Air Filtration, toxic dusts are a big concern in the chemical process industries, because they can have significant health and environmental concerns, so efficient capture and filtration are a high priority.

Jacques Kregting, technical sales and applications engineer with RoboVent (Sterling Heights, Mich.; robovent.com), explains that U.S. Occupational Safety & Health Administration (OSHA; Washington, D.C.; www.osha.gov) sets Permissible Exposure Limits (PELs) for many chemical products that are enforceable by law. "Employers must ensure that workers are not exposed to inhalable dust at levels above the PEL, although many employers aim for lower limits, such as those recommended by other scientific bodies, such as the U.S. Centers for Disease Control and Prevention (CDC)'s National Institute for Occupational Safety & Health (NIOSH) or the American Conference of Governmental Industrial Hygienists (ACGIH; Cincinnati, Ohio; www.acgih.org)," says Kregting. "Even if dust is not considered toxic, OSHA sets limits on so-called 'nuisance dusts' to protect workers. The PEL for 'Particulates Not Otherwise Regulated' (PNOR) is 15 mg per cubic meter (mg/m^3) for total particulate matter and 5 mg/m^3 of air for the respirable fraction."

Catastrophic failures due to fires and explosions are another important safety concern, becasue many of the chemicals being processed may be combustible. "Combustible dust faces unique challenges, including potential combustibility, concentration and identifying possible ignition sources," says U.S. Air Filtration's Watson. "Understanding a dust's explosive potential, or *Kst* value, is critical to getting the appropriate equipment to mitigate an explosion. Identifying ignition sources is another factor that should be carefully considered as additions like spark traps, isolation dampers and abort gates may be needed to prevent or mitigate an explosion."

Because combustible dusts have the potential for catastrophe, processors dealing with combustible dust are required to complete a dust hazard analysis (DHA) and put mitigations in place that comply with guidelines laid out by the National Fire Protection Association (NFPA; Quincy, Mass.; www.nfpa.org) Standard 562 (Standard on the Fundamentals of Combustible Dust), says RoboVent's Kregting. "These mitigations include reducing the concentration of dust in the air and preventing the formation of dust clouds in enclosed spaces," he says.

To determine exactly what your facility requires in the way of combustible-dust control, Tony Galvin, pharmaceutical segment manager with Camfil Air Pollution Control (Jonesboro, Ark.; camfilapc.com), says process owners, as part of their overall risk assessment and strategy,

U.S. Air Filtration, Inc.

FIGURE 1. CleanFlo cartridge dust collectors from U.S. Air Filtration, Inc., are modular, compact industrial air filtration systems designed to capture fine dust particulate. They are ideally suited for applications with small to moderate dust load, fine dust particulate (<0.5-micron dust size), height and space restrictions, and airflow temperatures below 245°F.

need to be mindful that they perform a "complete" DHA.

"DHAs are often misunderstood as a simple requirement of having process dust tested, which is only one component," he says. "When authorities having jurisdiction (AHJs) ask for a DHA, they are looking for a complete report that includes dust testing results with the full details on which equipment may pose dust and/or fire risks, the locations within the facility that are also at risk, including electrical area ratings (Class I Division II) and detailed priority-oriented steps and timelines for remediating these issues," explains Galvin. "DHAs, as described in NFPA 652, are repeated at least every five years and must include administrative practices with ongoing documentation and training."

Other important concerns regarding dust control include maintaining product quality, avoiding contamination, equipment longevity, satisfying regulatory requirements and the environmental impact of chemicals and waste, points out U.S. Air Filtration's Brown.

In addition to the dust-related safety hazards, explosion risk and product contamination issues cited by Brown, dust can also create housekeeping issues. "Chemicals and specialty chemicals can generate dust byproducts during production cycles," says Galvin. "Chemical dust tends to be very fine and, if not properly controlled, can float high up in the facility and settle onto rafters, overhead HVAC [heating, ventilation and air conditioning] ductwork and light fixtures. In addition to creating safety hazards and cross contamination issues, this dust can pose challenges with housekeeping, requiring more downtime to clean."

"Mitigating dust throughout the production process will assist with all of these challenges and a dust collection system (Figure 1) is a great way to accomplish that," says U.S. Air Filtration's Brown. "Keeping equipment and production areas clean and free of nuisance dust will reduce the risk of cross-contamination, health and safety issues and the potential for combustion."

Effective, compliant dust control

"Local exhaust ventilation (LEV) is the term for engineering controls that capture dust at the point of generation," says Camfil's Galvin. "Capturing dust as close as possible to the point of generation will economize the air volume required for capture and greatly reduce the chance of dust migration. Because rogue noxious dust can be captured where it is created, it can be managed safely and efficiently removed from the process, which is the ultimate goal. Dust collectors (Figure 2) receive and manage this material, which can act as a fuel source in combustible events and should be part of safety strategies so that the overall process and employees are not impacted."

"This is why agencies, such as the U.S. Environmental Protection Agency (EPA), OSHA and NFPA, all recommend or require dust collection systems," says U.S. Air Filtration's Brown.

It should be noted that regulations for dust control in the chemical industry, as well as other industries, are always changing, both in the U.S. and internationally, says RoboVent's Kregting. "One big change coming later this year from NFPA is that they are consolidating several of their basic and industry-specific combustible dust standards into a new standard, NFPA 660, which is expected to go into effect in fall 2024. This consolidates NFPA standards 61, 484, 652, 655 and 664. However, the consolidated standard does not represent a major departure from existing standards."

In addition, chemical manufacturers must be aware of changing health, safety and environmental emission standards that impact their specific products and materials, notes Kregting. "For example, the EPA's Toxic Substances Control Act (TSCA) is due for inventory updates in 2025, which may introduce new additions to the chemicals included under these regulations. OSHA is also continually evaluating PELs for chemical substances based on new scientific evidence.

"As regulations change, dust collection systems may need to be updated to ensure continued compliance with PELs and emissions standards," Kregting says.

Camfil Air Pollution Control

FIGURE 2. Camfil APC's premium-quality dust collectors cost effectively collect many types of chemical dust, including toxic dusts, combustible dusts, cross-contaminant dusts and nuisance dusts. They ensure that all employees can work safely in facilities where dust is present

Once the dust-related risks and the appropriate standards have been identified, it is then possible to determine what type of dust collection system will best manage and mitigate the problems. "There are a lot of decisions to be made in dust-collection-system design and there are no one-size-fits-all solutions," explains Alysha Yinger, director of engineering with RoboVent. "The system must be tailored to the type and volume of dust produced, the hazard level and applicable PELs, process hazards and requirements, facility constraints and air quality goals.

"It is usually best to work with a qualified engineering firm that can look at all the variables and design a system that is safe, efficient and effective. Make sure the engineering firm complies with guidelines and standards laid out by organizations such as ACGIH, American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE) and NFPA," Yinger advises.

That said, some key decisions

FIGURE 3. The RoboVent Senturion, a dust collector for chemical and other industries producing large volumes of dust, is a modular system with components that fit together like building blocks

when creating a dust collection system, according to Yinger, include:

Source capture versus ambient collection. For most chemical manufacturers, a source-capture system is recommended to prevent chemical dust from propagating throughout the facility. Source capture is also more efficient, as it reduces the volume of air that must be moved.

Dust collector type. For most chemical processors, a cartridge-style dust collector is an effective and versatile choice. These systems use cylindrical, pleated cartridge filters to capture airborne contaminants and can be configured for a wide range of needs. When compared to baghouse collectors with similar airflow ratings, cartridge collectors tend to be smaller and more energy efficient. However, there are situations where a baghouse collector or specialty equipment, such as a wet collector, may be recommended.

Filters. Filter selection is very important in overall system effectiveness and efficiency. Filters come in a range of efficiency ratings. For fine and potentially hazardous chemical dust, a filter with a high efficiency rating — MERV (minimum efficiency reporting value) of 15 or higher — is usually recommended. For highly hazardous dust types, a HEPA [high-efficiency particulate air] filter may be used. If vapors or gas-phase emissions are present, manufacturers may want to consider an activated carbon afterfilter. It is also important to consider other characteristics. For example, is the dust abrasive, sticky, hygroscopic or electrostatic? Specialized filter media and coatings can help manage these situations.

System sizing and airflow. Dust collection systems are sized based on the volume of airflow required for effective dust capture — measured in cubic feet per minute (ft^3/min), or CFM — and the area of filter media needed per unit of airflow, or air-to-cloth ratio. Sizing is dictated by dust volume and characteristics and the total volume of air that must be moved.

Innovative technologies

"While the basics of dust collection and industrial air filtration haven't changed much in decades, there are some new innovations that make systems more efficient, more effective and easier to maintain," notes Yinger.

Among them are modular designs in modern cartridge dust collectors that make it easy to size and customize a system for a specific application. "For example, RoboVent Senturion (Figure 3), a dust collector for chemical and other industries producing large volumes of dust, is a versatile dust collection system built on a modular platform with components that fit together like building blocks," says Kregting. The modular design allows the creation of a dust collection system that can be adapted for virtually any dust or fume collection application and configured around the physical constraints of the facility. When combined with RoboVent's PleatLock filter technology, which allows for 35% more usable filter media in the same cartridge space, Senturion offers the smallest footprint for the ft^3/min available, he says.

Other advances in filters, include an entirely new class of filters developed by W.L. Gore (Putzbrunn, Germany; www.gore.com), says Ed Harrington, strategic account manager with Gore. "Our Low-Drag technology offers new materials that are inherently less resistant to airflow and more efficient, requiring less energy to drive air through during filtration while providing the industry's best particulate capture efficiency. Using Low-Drag technology (Figure 4) allows users to increase airflow, reduce system pressure drop, lower electricity costs or further increase service life," says Harrington. "This flexibility allows users to choose the benefit that is most valuable to their process."

And because energy efficiency is indeed a growing concern, some collection systems offer variable frequency drives (VFD) as an option. "VFD can be added to control panels to help manage blower motor energy based on operational needs," says Camfil's Galvin. "Historically, exhaust blowers, when started, would ramp up to their maximum designed speed and remain at 100% until being shut down, whether this was required or not. A VFD will regulate power to the motor based on need and will cycle up and down based on changes to pressure drop, which is the differential pressure inside the collector. VFDs on continuous-operation dust collectors can positively impact operational costs by paying for themselves within the first 12 months."

Trend toward monitoring

"Integration of dust collection equipment into other monitoring systems within a facility is becoming more common," says U.S. Air Filtration's Brown. "Considering dust collection equipment plays a critical role in a facility's operation, it makes sense to monitor it closely.

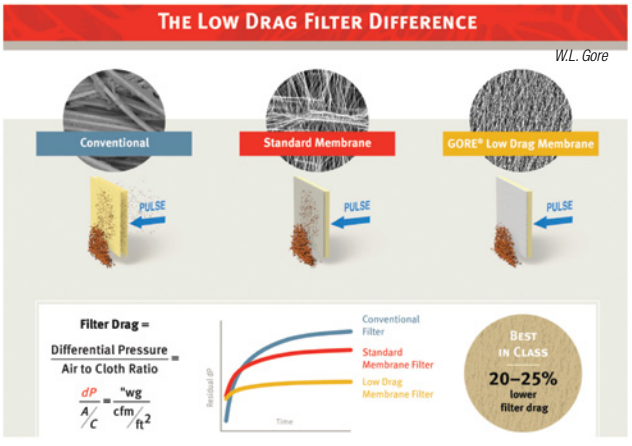


FIGURE 4. Low-Drag filter technology from W.L. Gore allows end users to increase airflow, reduce system pressure drop, lower electricity costs or further increase service life, giving users the ability to choose the benefit that is most valuable to the process

Emerson

FIGURE 5. Emerson's ASCO dust collector tanks, dust pulse valves (shown here), dust collector controllers and PACSystems PLCs, HMIs and Movicon HMI/SCADA are essential components of quality, cost effective dust control applications

"Sensors such as differential pressure gages, emission monitors and broken bag detectors can all be tied into a facility's PLC, allowing for real-time monitoring," Brown continues. "This ensures the system is operating efficiently and allows the operator to identify potential maintenance, safety or emission issues quickly."

"In addition to the use of a monitoring or controls solution, such as differential pressure transmitters that help track the functionality of the dust-collector-system efficiency and that filtration elements are performing properly, monitoring and controls solutions can also be implemented so the system can be optimized to reduce compressed air usage, prolong the lifetime of the filter bags and valves and even include visualization and maintenance alerts," adds Samuele Oliva, product marketing manager, dust collector systems for Discrete Automation at Emerson (Charlottesville, Va.; emerson.com).

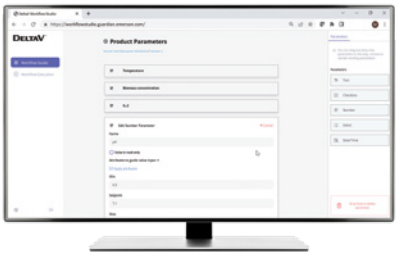
Oliva continues: "Added technologies in dust collector systems, like particulate sensors, are becoming more popular to showcase the functionality of the dust collector system and provide data about the filtering process, such as how much particulate matter is passing through the system.

"More advanced controls are another trend where, through more honed differential-pressure methods, the pulse valves (Figure 5) can be pulsed only when needed in the pulse-jet style of cleaning," says Oliva. "Visualization and alerts can assist with maintenance of the system, reducing downtime and even translating the system data into reports that can be sent to government regulators."

Because the dust collection needs of each facility differ, dust collection systems are custom designed for a particular use case and understanding the dust characteristics and production nuances can mean the difference between a system that works efficiently and with minimal maintenance and one that does not provide adequate control and is a maintenance nightmare. Whether a facility opts to embrace the latest innovations or continue with a traditional dust collection system, a suitable and compliant dust control solution is an essential part of the safety of employees and the facility, as well as the quality of products. ■

Joy LePree

Focus on Software



Emerson Electric

Command Alkon

EcoOnline

Metso

Software streamlines pharmaceutical development

DeltaV Workflow Management (photo) is a next-generation software designed for life sciences companies in early-stage development. For companies with limited information technology (IT) infrastructure, DeltaV Workflow Management provides a cloud-based, software-as-a-service (SaaS) solution for simple recipe authoring, execution and electronic data capture. DeltaV Workflow Management transitions recipe-workflow data from manual records to digital "paper on glass," providing a simple and scalable solution that helps accelerate the drug-development process with no coding experience required. The software also generates searchable digital records that are easily organized and exported, and data that can be more easily analyzed and reported. In addition, this digital shift minimizes the contamination risks associated with paper records in sterile clean rooms. — *Emerson Electric Co., Saint Louis, Mo.*
www.emerson.com

Software that Improves supply and demand visibility

Material Supply software (photo) combines the powerful capabilities of Command Cloud shared tickets, Ticket Accounting, COMMANDbatch and dispatch solutions into a cohesive raw material supply solution. Material Supply revolutionizes the way producers manage their inbound material deliveries. With the integration of Command Cloud shared tickets, suppliers can effortlessly share delivery tickets, eliminating the need for manual data entry by plant operators. Additionally, users can digitize paper tickets through mobile capture or scanners, ensuring a seamless transition to a digital workflow. — *Command Alkon, Birmingham, Ala.*
www.commandalkon.com

Ion-exchanger-design software with new functions

In March, this company released a new version of its LewaPlus design software with a significantly expanded range of functions. The calculation tool, which enables the dimensioning of ion-exchange systems (including individual process configurations) has been updated with improvements and additions in the modules for mixed-bed calculation, condensate polishing and the design of polishing stages in food-and-beverage production. The software also enables users to check the efficiency of existing systems and identify potential savings in operating costs. The new functionalities in the water-treatment application area, for example, include a module for designing mixed-bed systems with ready-to-use mixed-bed (MB) resins. The module makes it possible to design the filter hydraulics and allows a good estimate of the expected cycle time. — *Lanxess AG, Cologne, Germany*
www.lanxess.com

Software enables faster PFAS substitutions

This software provider for environment, health and safety (EHS), environmental, social and governance (ESG) and chemical safety, recently announced the availability of its Chemical Manager solution in North America for faster identification and substitution of PFAS (per- and polyfluoroalkyl substances), also known as forever chemicals. Chemical Manager offers user-friendly software to manage safety data sheets (SDSs), substitute chemicals, assess risks and report on chemical compliance. Chemical Manager offers a wide variety of features, including: Legislation Lists, Chemical Substitution Module and Chemical Approval Software. Chemical Manager software ensures continual compliance and saves time by managing SDSs in one online inventory with a powerful search tool and automatic updates from the EcoOnline database. — *EcoOnline, London, U.K.*
www.ecoonline.com

An app for remote control of crushers and screens

This company's intelligent crushing and screening offering is expanding with a new software application (app) called Remote IC (photo). The new Remote IC is used for remote control and monitoring of the crushing and screening process, and it connects all the Lokotrack crushers and screens wirelessly at the site. With Remote IC,

the operator can view all Lokotrack train machines and their main process parameters using a single dashboard. The feeder and crusher settings can be adjusted safely from the excavator cabin, and the overall visibility of the process allows the operator to adjust the feeding for an optimal production level. If a problem occurs, the Remote IC automatically stops the feeder, thus preventing overloading. It also instantly alerts and provides a reason for the stoppage, making it quicker and easier to get back to operation. With a lower overflow risk, the process can be run closer to maximum capacity. — *Metso Corp., Espoo, Finland*
www.metso.com

Software identifies vulnerable production assets

To address the need to identify cybersecurity vulnerabilities on the shop floor as quickly as possible, this company recently launched a new cybersecurity SaaS. The cloud-based SINEC Security Guard (photo) offers automated vulnerability mapping and security management op-

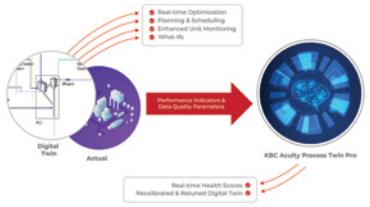
timized for industrial operators in OT environments. The software can automatically assign known cybersecurity vulnerabilities to the production assets of industrial companies. This allows industrial operators and automation experts who lack dedicated cybersecurity expertise to identify cybersecurity risks among their OT assets on the shop floor and receive a risk-based threat analysis. The software then recommends and prioritizes mitigation measures. — *Siemens Digital Industries (DI), Nuremberg, Germany*
www.siemens.com

AI-powered app accelerates digital transformation

In July, this company released KBC Acuity Process Twin Pro (photo, p.20), a web-based SaaS application. This artificial intelligence (AI)-powered application leverages rich-data analytics and optimization methods to automatically monitor and update the company's Petro-SIM digital-twin solution to ensure consistent value is delivered. From one centralized platform, KBC Acuity Process Twin Pro technology provides meaningful insights to help petroleum refiners accelerate decision-making and facilitate efficient asset management and operational effectiveness. These aspects are crucial to achieve growth, scalability, sustainability and profitability. — *KBC, a wholly owned subsidiary of Yokogawa Electric Corp., Walton on Thames, U.K.*
www.kbc.global

AI platform enables 65% CO_2 reduction in cement production

This young startup company uses machine learning (ML) and control technology to predict the quality properties of cement and concrete. Through robust data and smart algorithms, the company offers relevant



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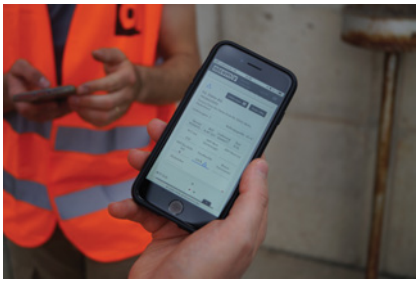

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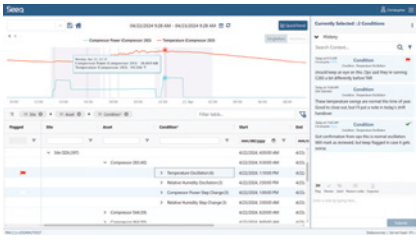
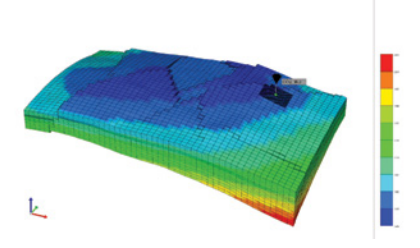


Seeq Corp.



Kongsberg Digital

insights along the entire value chain in real time. With this company's solution (photo), cement producers benefit from higher quality, lower production costs and massive CO_2 savings. In July, the company announced it had raised a $10-million funding round to scale its cement decarbonization solution. Also recently, the company's partnership with Spenner, Germany's fifth-largest cement manufacturer produced a low-clinker, low-carbon cement mixture in a commercial setting — a first for the industry globally. — *alcemy GmbH, Berlin, Germany*
https://alcemy.tech/en

Monitor the entire enterprise with this new suite

The Industrial Enterprise Monitoring Suite (photo) provides a comprehensive, automated view into operational performance — past and present. This broader view enables better decision making and continuous improvement across today's complex, industrial ecosystems. The Industrial Enterprise Monitoring Suite leverages the combined power of the company's Industrial Analytics and AI Suite and the context that only teams of experts can provide — all at the scale needed to drive impactful results across the operational footprint. The new suite provides the flexibility, speed and robust capabilities needed to operationalize a condition-based prioritization and decision strategy, and helps ensure decision-makers have key insights at their fingertips, allowing for faster, better decisions and actions. — *Seeq Corp., Seattle, Wash.*
www.seeq.com

Modeling the transport and injection of CO_2

This company and Computer Modelling Group (CMG; Calgary, Canada) have launched CO2Link, a transformative simulator coupling that streamlines CO_2 injection and storage processes. This simulator coupling software enables seamless modeling of the interaction between well and reservoir systems, traditionally treated as separate entities. Developed as part of the GELECO2 joint industry project (JIP) — a consortium of 12 energy companies supported by CLIMIT, Norway's national research program for carbon capture solutions — the CO2Link software integrates this company's advanced transient multiphase flow simulator, LedaFlow, with CMG's reservoir simulator, GEM. The software allows operators to better anticipate and navigate potential bottlenecks and challenges effectively, significantly advancing from the previous methods that relied on spreadsheets to connect reservoir and pipeline simulations. — *Kongsberg Digital, Asker, Norway*
www.kongsbergdigital.com

New capabilities for developing HMI/SCADA

In June, this company announced updated capabilities and commercial models for its InTouch Unlimited HMI/SCADA software. New features, optimized commercial models and pricing make it easier for end users, original equipment manufacturers (OEMs) and systems integrators (SIs) to develop and scale HMI/SCADA applications from edge-to-cloud, with the ability to incorporate analytics and Connect, this company's industrial intelligence platform. InTouch Unlimited is an all-inclusive licensing package available in perpetual and subscription models with unlimited tags, clients and scalability. The InTouch Unlimited package features comprehensive process historian and reporting functionality, equipping users with the ability to collect and unlock the value of data sourced at the edge, and from multiple plants and systems spanning the enterprise. — *Aveva Solutions Ltd., Cambridge, U.K.*
www.aveva.com

Further democratizing Python for data science, AI use cases

In July, this company announced a new integration with Snowflake Notebooks (public preview), a cell-based development interface integrated within Snowflake's secure, scalable platform. Snowflake Notebooks provide a convenient, easy-to-use development interface for Python, SQL, and Markdown to accelerate development using Snowflake offerings, including Snowflake ML, Streamlit and Snowflake Cortex AI. The integration brings this company's secure, efficient and robust Python packages within Snowflake Notebooks directly to accelerate data science, machine learning and AI development. This integration empowers users to keep their data and development workflows within Snowflake's secure and scalable platform. — *Anaconda, Inc., Austin, Tex.*
www.anaconda.com

Gerald Ondrey

Focus on Water Treatment

A novel spacer technology for RO membrane elements

This company's reverse-osmosis (RO) elements (photo) use a unique Printed Spacer Technology that improves the performance of systems with just the change of the membrane element. The technology replaces mesh spacers that have been used for decades with printed features on the membrane surface, improving the flow of water through the membrane element. Printed spacers open the feed channel inside of the element by using far less material. This results in superior spiral-wound membrane performance, improving system output, element life and energy usage, says the company. In addition to improved operations, customers also enjoy lowered operating costs and support meeting sustainability goals. The BW product line has two feed-spacer options: ECO, designed to save up to 60% of wasted energy, especially suitable for companies with challenging feedwater or those looking for ways to save on electricity costs and achieve their ESG goals; and FLO, which optimizes output by taking full advantage of the more than 500 ft^2 of membrane surface. This configuration is ideal for applications where a system is struggling to keep up with demand, has limited space for a water treatment system, or is only operated for a short period of time. — *Aqua Membranes, Albuquerque, N.M.*

www.aquamembranes.com

High-efficiency electrolysis for sodium hypochlorite

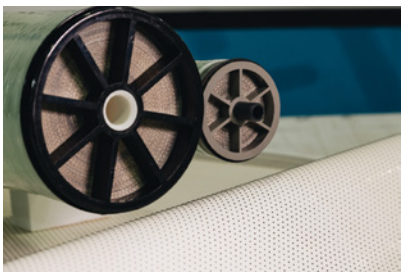
CECHLO-MS is an onsite, high-strength sodium hypochlorite generator (photo) with a patented ion-exchange membrane that safely produces 12.5% sodium hypochlorite, sodium hydroxide or chlorine gas. The technology is used for process water and wastewater treatment, including reuse applications, bleach manufacturing and wholesale chemical production. CECHLO-MS is a safe, economical and energy-efficient technology that poses no risks associated with delivering and storing hazardous chemicals and does not require special training or certifications, according to the manufacturer. Three simple and common consumables are required to generate the powerful chlorine-based disinfectant on-site: salt, water and electricity. At the heart of the CECHLO-MS 200 system is a highly efficient, proprietary electrolyzer. CECHLO-MS-200 systems are equipped with latest generation of this company's proprietary DSA electrodes that help to maximize efficiency and energy savings. — *De Nora, Milan, Italy*

www.denora.com

Drum screens made for high-flow and high-solids streams

This company's internally fed rotary-drum screen (photo), the first of a new Drum Line product family, applies proven and adaptive screening technology to fine screening for municipal and industrial water-treatment applications. Engineered for sites with both high flows and high solids content, the product is designed to manage difficult-to-capture debris and protect sensitive treatment processes, such as membrane bioreactors (MBR), from fine particles and fibers. The new drum screen is said to combine mechanical simplicity, trouble-free maintenance and long product life for treatment process reliability and increased efficiency. Key design features overcome the two major challenges historically associated with drum screening — clogging and corrosion. For instance, trunnion wheels have been replaced with stainless-steel shoes. The devices are also equipped with ultra-high molecular weight (UHMW) polyethylene, water-lubricated wear strips and a direct-drive system that eliminates chains and sprockets and is positioned outside of the wet area. With few wear parts, a fractional horsepower motor and minimal user intervention, users can reduce operating expenses. — *Duperon Corp., Saginaw, Mich.*

www.duperon.com



Aqua Membranes

De Nora

Duperon

Huber Technology

Jacobi Carbons

Process Wastewater Technologies (PWTech)

MentorAPM

Bedford Reinforced Plastics

A rotating drum screen designed for septage handling

The RotaShield is a rotating drum screen (photo) offering high performance in extreme applications, such as sludge acceptance, because it protects the treatment facility from high-strength waste, rags, bottles, rocks, grease and grit. The screens' unique design eliminates common issues associated with septage receiving and traditional auger-type screens, because it has no internal auger, trough, tank or seals. The RotaShield offers unloading up to 1,400 gal/min and can offer the convenience of unloading multiple trucks at the same time. RotaShield drums feature a compact, space-saving design with low energy demand. A completely encased unit, the stainless-steel design makes the RotaShield able to be sustained far beyond the traditional lifecycle of products in such corrosive environments, says the manufacturer. — *Huber Technology, Inc., Denver, N.C.*

www.huber-technology.com

New renewable extruded carbon for odor removal

AddSorb OX Series of coconut-shell-based extruded carbon materials are designed for use in odor removal in the biogas industry, offering high H_2S capacity (minimum of 0.3 g/cm^3). The product is a non-impregnated grade with low ash and high purity, and maintains the signature low pressure drop associated with pelletized carbon. This new grade of extruded carbon replaces products based on coal and other fossil fuels with alternative, renewable raw materials. With coconut shell as the primary raw material, the global warming potential of the AddSorb OX Series is significantly less than that of coal-based carbon. — *Jacobi Carbons, Inc., Columbus, Ohio*

www.jacobi.net

This belt dryer operates at lower temperatures

The PWTech plate belt dryer with Dorset technology differentiates itself from traditional belt dryers through its perforated steel plates. Unlike the woven belt found in conventional belt dryers, the perforated plate system lowers air resistance and ultimately energy consumption by up to 50%, and it can achieve two passes with each belt, says the company. The plates are available in stainless steel or powder-coated galvanized steel for protection against corrosion. Utilizing low-temperature heating, the system runs on hot water, allowing for multiple, and exchangeable heat sources, including waste heat, natural gas or a heat pump. Operating at a lower temperature, this plate dryer virtually eliminates the risk or fire or explosion, and reduces odors and dust. — *Process Wastewater Technologies LLC (PWTech), Rosedale, Md.*

www.pwtech.us

Asset-management software with utilities expertise

MentorAPM software (photo) delivers end-to-end asset-lifecycle management in a single platform. From work orders to capital plans, it helps identify risk, set priorities and target resources for a resilient and sustainable operation. The application, its architecture and over 335 asset models with libraries grew directly out of the founders' experience working with diverse organizations across a broad spectrum of industry and large utilities. MentorAPM delivers strategies to balance performance, risk and cost constraints to extend asset life. Embedded best practices and asset-management intelligence help to accurately identify risk and the current condition of assets to offer decision-making support for targeted priorities. Booth 1241 — *MentorAPM, Phoenix, Ariz.*

www.mentorapm.com

FRP safety structures now with specialized protective coatings

The ReadySeries lineup of fiberglass-reinforced plastic (FRP) products is said to be the broadest line of FRP modular structures for the water-quality industry. The ReadySeries family comprises platforms, mezzanines, walkways, catwalks, fixed ladders, handrails, guardrails, stairs, pedestrian bridges and more. Each modular product can be used independently or combined with other products in the series. A particular highlight of the series is the availability of the proprietary ReadyShield UV-resistant coating to protect against harsh weather, extreme heat and humidity, as well as potential for fiber bloom, which can expose and weaken fiber integrity. — *Bedford Reinforced Plastics, Bedford, Pa.*

www.bedfordreinforced.com ■

Mary Page Bailey

Efficiency in Electric Induction Motors

Department Editor: Scott Jenkins

The purchase price of an electric motor is generally thought to end up as a small fraction (2–3%) of the motor's total lifetime cost, with the majority of costs resulting from the electricity used by the motor. This makes motor efficiency a key parameter for the cost of operation. This one-page reference reviews concepts important to motor efficiency, focusing on three-phase, "squirrel-cage" induction motors. This type of motor is commonly used to drive rotating equipment, such as pumps, blowers, fans and compressors, as well as other mechanical equipment, in the chemical process industries (CPI).

Induction motors

In an induction motor, an iron rotor assembly on a shaft rotates within a stator, a stationary housing containing copper wires. The induced magnetic field of the stator winding induces a current in the rotor. If the stator windings and stator slots are designed correctly, applying alternating current to the stator will generate a rotating magnetic field. When electrical current is applied, the rotating magnetic field turns the motor shaft. Typically, three-phase alternating-current (a.c.) electric power is supplied to the stator so that the three phases are electrically separated from each other by 120 deg. For more information about induction motors, see Ref. 1.

Motor efficiency

The efficiency of an electric motor is a measure of the effectiveness with which the input electric energy is converted to output mechanical energy. The National Electrical Manufacturers Association (NEMA; Arlington, Va.; www.nema.org) defines energy efficiency as the ratio of a motor's useful power output to its total power input and is usually expressed in percentage (Equation 1) [*2*].

$$\eta = (0.7457 \times hp \times Load)/P_i \quad \textbf{(1)}$$

- η = efficiency as operated in %
- hp = nameplate rated horsepower

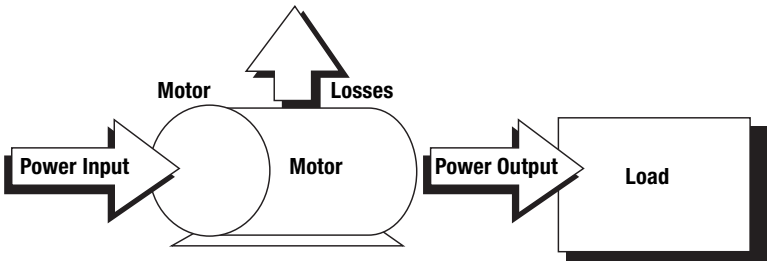


FIGURE 1. Electric motor efficiency is a ratio of power input to output. Motor designers seek to minimize energy losses, which can result from several sources (Diagram adapted from U.S. Department of Energy)

- *Load* = output as a % of rated power
- P_i = Three-phase power, kW

Higher efficiency is achieved with improved rotor-stator design and higher-quality materials.

Motor losses

There are several categories of electrical losses, which can reduce the efficiency of the motor (Figure 1). Three are described briefly here.

Ohmic losses. As input power is applied to the motor, the engine components exhibit resistance, which results in electrical loss that dissipates as heat. Combining Ohm's Law (voltage = current × resistance) with the Power Law (power = voltage × current) shows that the power lost equals product of resistance and current squared. The major component of Ohmic loss (also known as I^2R loss) is the stator, but I^2R loss also occurs in the rotor bars of the motor. These losses can be reduced by increasing the conductor's cross-sectional area, improving the motor winding technique, and using materials with higher electrical conductivities.

Mechanical loss. Mechanical losses are the result of friction from the rotating shaft and can occur in motor bearings, for example. Frictional losses depend on the motor's speed. Maintaining proper bearing lubrication helps reduce frictional losses.

Iron loss. This category includes losses from hysteresis, resulting from reorientation of the magnetic field within the motor's lamination steel, and eddy current losses resulting from electrical currents produced between laminations due to the presence of a changing magnetic field [*3*].

Motor efficiency standards

Two main standards address electric motor efficiency and categorize motors into efficiency classes: the International Electrotechnical Commission (IEC; Geneva, Switzerland; www.iec.ch) standard 60034-30-1 [*4*], used widely in Europe and Asia and elsewhere, and the National Electrical Manufacturers Association (NEMA; Arlington, Va.; www.nema.org) standard MG-1 [*5*], more common in North America. The IEC and NEMA standards provide for the global harmonization of energy-efficiency classes of electric motors.

For example, when classifying motors according to their efficiency, IEC has four classes: IE1 (standard efficiency); IE2 (high efficiency); IE3 (premium efficiency); and IE4 (super-premium efficiency). IE4 motors are capable of 97% efficiency. In future revisions of the standard, an even higher efficiency class (IE5) is planned.

Premium efficiency motors are particularly cost effective when annual operation exceeds 2,000 hours, utility rates are high, motor repair costs are a significant fraction of the price of a replacement motor, or electric-utility motor rebates or other conservation incentives are available. ■

References

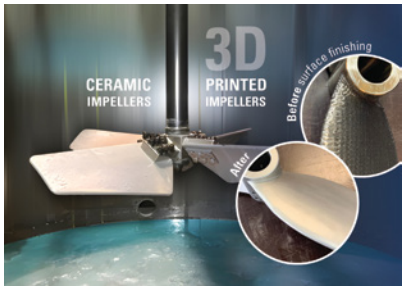
1. Jenkins, S., Alternating-Current Induction Motors, *Chem. Eng.*, July 2022, p. 20.
2. U.S. Department of Energy, Energy Efficiency and Renewable Energy (EERE) Office, When to Purchase Premium Efficiency Motors, Motor Systems Tip Sheet #1, 2012. https://www.energy.gov/eere/iedo/motor-systems
3. OSWOS, Losses in Electric Motors, Training Video, Berlin, Germany, www.oswos.com
3. International Electrotechnical Commission (IEC), International Standard IEC 60034-30-1, Efficiency Classes of Line-Operated AC motors (IE code), IEC, Geneva, Switzerland, www.iec.ch, 2014.
5. NEMA MG1, https://www.nema.org/standards/view/motors-and-generators

New Products

Alleima AB

WIKA Alexander Wiegand

TWTG



Ekato Holding

Automated Flexible Conveyor

New compressor-valve for refrigerators and freezers

Freeflex Versa (photo) compressor-valve steel is a new material that contributes to designing smaller, more sustainable and more energy-efficient compressors for refrigerators and freezers. Building upon the success of its predecessors Hiflex and Freeflex Core, this martensitic stainless steel is engineered with a focus on catering to the unique requirements of reciprocating and linear technologies. Notable features of Freeflex Versa include exceptional fatigue resistance, outstanding wear resistance and the ability to contribute to noise reduction and downsizing, the company says. The compressor-valve steel is suitable for a variety of applications, including air-conditioning equipment, heat pumps, refrigerators, freezers and clothes dryers. — *Alleima AB, Sandviken, Sweden*
www.alleima.com

A vibrating level switch for general-purpose applications

This company has supplemented its portfolio with a vibrating level switch (photo) that is suitable for all liquids, including highly viscous media. The new instrument is available in three variants for different market segments. The model TLS-S is intended for the process industries and can also be delivered with ATEX approval. Thanks to its hygienic design, the model TLS-H meets the requirements of the food and pharmaceutical sectors. The particularly compact model TLS-C has been designed for OEM applications. Due to its functional principle based on a tuning fork as the measuring element, the vibrating level switch enables precise limit-level monitoring in containers and pipelines, irrespective of the mounting position. — *WIKA Alexander Wiegand SE & Co. KG, Klingenberg, Germany*
www.wika.de

Valve sensor enables fast deployment without downtime

In July, this company released its newly redesigned NEON valve sensor (photo). The NEON QT valve sensor, distinguished by its adaptability, now features an entirely redesigned assembly for universal compatibility with any quarter-turn valve on the market. This innovation, coupled with a user-friendly 45-deg slotted bracket, allows for installation in under two minutes without valve operation or the need for calibration. This deployment with zero downtime is particularly suited for valves that cannot be adjusted during installation, such as those in continuous processes. The NEON valve sensor has been certified to operate safely in explosive atmospheres (ATEX zone 1 / IECEx class 1), with a temperature range from –40 to 80°C. — *TWTG, Rotterdam, the Netherlands*
www.twtg.io

Printing abrasion-resistant mixing impellers

This company develops abrasion-resistant impellers using advanced materials and optimized designs. These innovations enhance equipment reliability and have proven successful in demanding applications, such as hydrometallurgy and pressure vessels, leading to extended lifespans and increased plant profitability. By reducing both initial and ongoing costs, the company's ceramic impellers offer exceptional value to plant operators seeking superior performance and economic success. This company launched a development project to explore the use of hybrid manufacturing, which merges 3D printing with conventional methods. This approach enables the creation of complex geometries while remaining cost-effective, paving the way for highly efficient impeller designs. Hybrid and conventionally manufactured products can no longer be distinguished once the surface finishing process has been completed (photo), the company says. — *Ekato Holding GmbH, Freiburg, Germany*
www.ekato.com

Conveyor screw design prevents aeration in conveying

The flat-edge spiral-screw conveyor design (photo) features a broad, flat edge that minimizes the potential for aeration to add volume to low-bulk-density materials during transfer. Offered with the company's Spiralfeeder flexible-screw conveyor, the new design is suitable for transferring cake

mixes, starches, mica, fly ash, carbon black and other dry, low-bulk-density powders, pellets, flakes and granules. Consistent, uniform conveying at high throughputs is assured without clumping, clogs or compaction. Customized based on the material properties, target throughput rate and other factors, the flat-edge spiral design is machined from 100% stainless steel as standard and is available with a polished surface finish for sanitary processing. — *Automated Flexible Conveyor, Inc., Clifton, N.J.*
www.afcspiralfeeder.com

A new high-flashpoint heat-transfer fluid

This company has launched an upgraded version of Globaltherm HF, a high-temperature thermal fluid with one of the highest fluid flashpoints (280°C) on the market (photo). Its high flashpoint and blend of additives makes it a durable option for manufacturers operating thermal fluid systems. Globaltherm HF is suitable for applications requiring single-fluid heating and cooling applications, including plastics processing, molding, casting, paint and chemicals. It has an operating range from 5°C up to a maximum bulk temperature of 338°C. This heat transfer fluid delivers superior resistance to sludging and extreme oxidation found in many manufacturing environments, the company says. — *Global Heat Transfer Ltd., Stone, Staffordshire, U.K.*
www.globalhtf.com

Foldable impellers for closed lid mixing

This company's folding impellers (photo) are designed to enter through the small container openings often encountered in closed-lid mixing environments, then expand to their full operating diameter as the mixer shaft rotates. Standard two-blade folding impellers are sized for use with 2-in. standard bungs up to 6-in. tote openings. They have operational diameters from 2-3/8 to 14 in. The folding impellers provide high-performance mixing, ensuring homogeneity and efficiency. Closed-lid mixing minimizes the risk of external contamination, and reduces splashing and spillage, making clean-up faster and easier. Models are available in 304 and 316/316L stainless steel, with some small-diameter plastic impellers available for laboratory-scale applications. — *Indco, Inc., New Albany, Ind.*
www.indco.com

Control high volumetric flowrates with this valve

This three-way ball sector valve (photo) — said to be the world's first — achieves high volumetric flowrates that are virtually identical in all directions. The company's approach of using the ball sector design for three-way valves is said to be completely new, and achieves about 20% higher K_{VS} values than three-way valves with a conventional design. These high flowrates are achieved through the special design of the ball sector and the valve body. The resulting straight flow in one direction and the minimized flow deflection in the other result in the very high and almost identical K_{VS} values. Superior control accuracy is ensured by the optimized contour of the ball sector and its backlash-free bearing, together with the actuator and positioner. The positioning angle of 90 deg enables a very large control range to be achieved. The rangeability is 300:1. — *Schubert & Salzer Control Systems GmbH, Ingolstadt, Germany*
controlsystems.schubert-salzer.com

Hybrid cooling system balances water and energy use

This new state-of-the-art hybrid cooling system (photo) is designed to deliver exceptional thermal performance while minimizing environmental impact. The system offers a perfect balance between water and energy consumption while setting a new standard in the heat-rejection industry. Designed to bridge the gap between standard adiabatic coolers and cooling towers, the hybrid offers two cooling modes: dry and wet. In dry mode, heat is exchanged with ambient air via its sensible enthalpy. For wet mode, the system waters the coil and uses both the water-sensible and latent enthalpy via an adiabatic effect where air evaporates the water. This allows the system to work with ambient dry-bulb temperatures well above process-fluid outlet temperatures. — *Kelvion Holding GmbH, Herne, Germany*
www.kelvion.com

Gerald Ondrey

Global Heat Transfer

Indco

Schubert & Salzer Control Systems

Kelvion Holding

Automatic Scraper Strainers for Wastewater Treatment

Advanced strainers are designed to offer far greater reliability than conventional options under unpredictable conditions. An industry expert provides insight into strainer use, design, selection, installation and construction

Robert Presser
Acme Engineering

IN BRIEF

Plants in the chemical process industries (CPI) have long relied on strainers to filter liquids and slurries of particles and impurities, as well as to protect downstream equipment, such as pumps, valves and heat exchangers, from damage due to debris and other contaminants. As such, they play a vital role in the manufacturing of products such as acids, alkalis, fertilizers, inks, paints, coatings, soaps, detergents, toiletries, perfumes, explosives, glues and essential oils.

Strainers also play a critical role in the wastewater treatment systems used in chemical processing. Often placed after clarifiers that settle suspended solids from liquids, strainers can remove contaminants of many different sizes, from small organic material to large debris prior to additional processing. This helps to reduce maintenance and facilitate compliance with regulations such as those contained in U.S. Environmental Protection Agency Clean Water Act.

Cooling water brought in from nearby oceans, lakes or rivers must also be strained to remove detritus and particulate matter. Process cooling-tower water in open and closed-loop systems is also filtered to remove scale, grit, fine sand and biological matter.

With so many possible applications, many chemical processors are now turning to self-cleaning systems. Advanced automatic scraper strainers can filter out both large and small particles, as well as adjust to unpredictable conditions, such as varying pressure, particle size, solids load and even the presence of sticky biological materials.

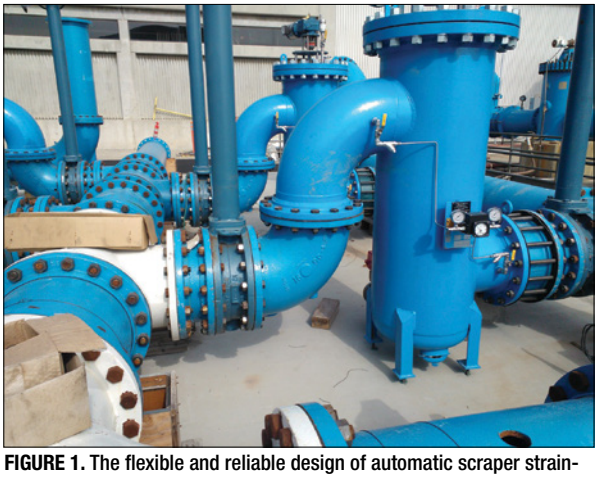


FIGURE 1. The flexible and reliable design of automatic scraper strainers helps protect downstream equipment while effectively processing wastewater

These more automated systems essentially eliminate manual handling and maintenance, including the need to open and dump debris and contaminants (Figure 1).

Designed for variability

Today, automatic scraper strainers are designed to tolerate "surprises," while also meeting various process, cooling and water treatment requirements. As an example, advanced units are designed to remove both very large and very small suspended solids.

This is accomplished by a spring-loaded blade and brush system, managed by a fully automatic control system. Four scraper brushes rotate at 8 rpm, resulting in a cleaning rate of 32 strokes per minute. The scraper brushes insert into wedge-wire slots and dislodge resistant particulates and solids. This approach enables the scraper strainers to resist clogging and fouling when faced with large solids and high

solids concentration. It ensures a complete cleaning and is very effective against organic matter "biofouling" (Figure 2).

To protect sensitive membranes, process cooling equipment, and wastewater treatment systems downstream of the clarifiers, 200-µm automatic scraper strainers can be used to filter up to 6,000 gal/min of the water and spillover. After washdowns, the technology can effectively capture even sticky biological substances, like algae, and other contaminants that are washed loose. This can protect additional downstream processes, such as membrane filtration or ozone-disinfection equipment, which could be utilized if further purification or inactivation of pathogenic organisms is required.

An advantage of automatic scraper strainers is that the technology does not require continuous water pressure to keep the screen clean. Unlike backwash strainers, scraper strainers do not rely on a pressurized backwash to remove solids from the screen. Instead, a blade and brushes provide more reliable cleaning under varying conditions.

The blade and brushes scrape the screen clean, and the small brush filaments get into the slots. So, if a solid is stuck in a slot between the wedge wire, the filaments will push the solid through (Figure 3).

Scraper strainers allow the solids to accumulate at the bottom of the vessel, where the blowdown valve will open periodically to clear them out. Since a gate valve isolates the solids collection area, the wastewater flow continues in the regular section of the strainer.

Blowdown occurs only at the end of the intermittent scraping cycle when a valve is opened for a few seconds to remove solids from the collector area. Liquid loss is well below 1% of the total flow.

The blowdown can operate without moving parts and can even perform from the suction side of a pump. These capabilities, which are not possible for a backwash unit, aid design flexibility and can facilitate installation at space-constrained plants.

Unlike a manual strainer, it is not necessary to open and clean an automatic scraper strainer. No one needs to manually blow down the solids. Since the operation of the scraper strainer is automatic, it is essentially a "set-and-forget" type of system that lets operators walk away and focus on other aspects of the facility, which helps to reduce overall labor costs.

Strainer selection

Selecting an automatic scraper strainer for chemical processing, cooling or wastewater treatment involves assessing various factors. Initially, the flowrate capability of the strainer, which is closely linked to viscosity, should be considered.

Evaluating the fluid's flow and viscosity guides the selection of an appropriate pipeline size. If a slower flow is preferred by the chemical processor, opting for larger piping might be necessary. When dealing with high-viscosity fluids, choosing a larger pipe diameter can facilitate smoother fluid movement. Introducing heat to reduce viscosity could also be recommended, particularly in petrochemical applications, such as bunker fuel, where optimal flow occurs at higher temperatures.

Regardless of the fluid type, the analysis extends to the content being transported, including the size and concentration of solids present in the flow.

When the fluid exhibits high viscosity and contains a significant solids concentration, it is generally necessary to use a larger strainer for situations where the processor opts against altering the pipeline dimensions. The strainer should be oversized to handle the anticipated high solids content. As the flow progresses through the pipeline, the solids remain suspended within the flow, potentially increasing the weight of the media, but not necessarily impeding its movement.

An alternative approach involves elevating the pump pressure to sustain the desired flowrate. Upon reaching the filtration screen of the strainer (a porous barrier), smaller solids are likely to pass through while larger particles are retained.

The subsequent consideration revolves around determining the necessary surface area for the filtration screen, contingent upon the desired level of filter fineness. Coarse filtration primarily targets the removal of larger particles, such as 0.5, 0.25 or even 0.125 in. Because the aperture size in the filtration screen is of substantial dimensions, its impact on pressure drop is minimal.

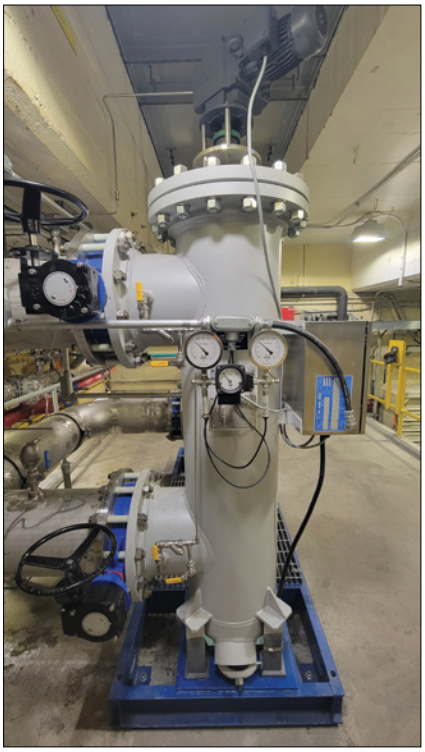


FIGURE 2. Automatic scraper strainers resist clogging and fouling when faced with large solids and high solids concentration

Nonetheless, as the strainer filtration size progresses toward finer specifications below 300 µm, such as 250 or 200 µm, the chemical processor must contemplate enlarging the screen's dimensions to counter a notable pressure drop.

Upon the initial selection of the strainer size, subsequent adjustments to the screen's dimensions will be made based on the specific constituents requiring extraction from the fluid, while maintaining an acceptable level of system pressure drop.

When a strainer is being selected, it is crucial for the processor to provide sufficient information to ensure the correct choice for the application. Providing a flowrate, solids loading and desired filtration level is generally satisfactory. However, having comprehensive information about the entire system allows for a more informed decision-making pro-

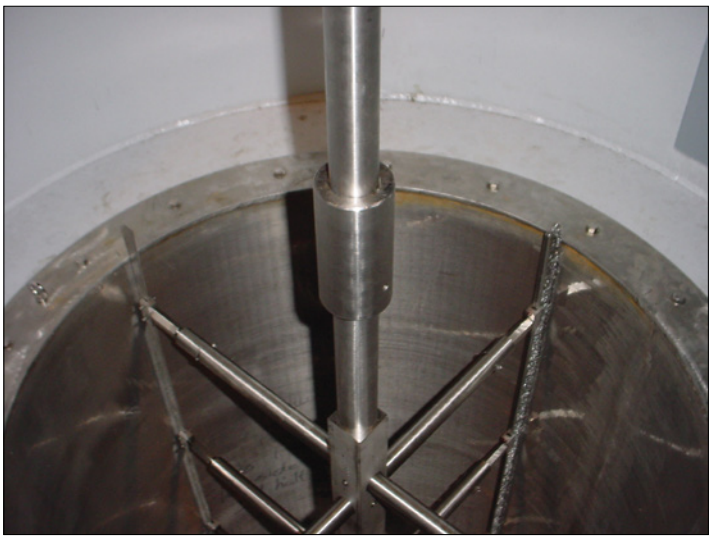


FIGURE 3. The self-cleaning scrapers filter out both tiny particles and larger debris, utilizing a blade and brush that work together to keep all straining surfaces fully effective and free of obstruction

cess. Potential issues downstream from the desired strainer location can be identified by examining the piping and instrumentation diagram (P&ID) for the process.

For instance, if 500-µm straining is required, but subsequent membrane filters demand 100-µm filtration, there is a conflict. This poses a challenge in addressing the filtration requirements. Transparency is key. Sharing information with the filter manufacturer enhances the success of the process. If confidentiality is a concern for the chemical processor, a nondisclosure agreement can be signed to safeguard intellectual property contained in the P&ID.

Strainer location

In challenging industrial applications, chemical processors must make a critical decision regarding the positioning of the strainer in relation to the pump. For highly viscous fluids, positioning the strainer after the pump is recommended. This typically requires a specialized pump, like a sludge pump or a positive displacement pump, that pulsates the solids. An alternative approach involves utilizing a combination system with a macerator placed before the pump to reduce the solids size for optimal strainer performance. The macerator operates effectively without requiring pressure.

There are certain instances where the strainer is positioned before the pump. Ideally, a positive-pressure system is preferred over a vacuum setup. However, appropriate measures can be taken to address vacuum conditions. One design solution involves incorporating a collector at the bottom, flanked by gate valves that facilitate isolation of collected solids for discharge. This design allows for effective operation even in the presence of minimal vacuum, because the collector can be isolated during discharge.

Alternatively, a small pump on the blowdown line can be utilized to extract solids from the strainer. This method has been successfully implemented in scenarios with limited positive pressure, typically in the range of 1–2 psi, and where transportation of blowdown material was required over significant distances. In such cases, relying solely on low pressure is insufficient, necessitating the use of a secondary trash pump to facilitate solid movement.

Materials of construction

In corrosive chemical processing settings, the utilization of stainless-steel construction instead of coatings on small 1- to 6-in. straining systems could be a more economical and appealing option. Coating involves a consistent time investment regardless of unit size, leading to disproportionate costs associated with smaller units.

For larger units, the implementation of a lining may offer a more cost-effective solution. An example includes a scenario where a 48-in. carbon-steel vessel with a 30-in. connection required a corrosive application that was lined with duplex stainless steel, featuring a chromium content of up to 22%. In this setup, the components in contact with water were constructed of duplex stainless steel, while the pressure vessel itself remained carbon steel, representing a cost-effective approach.

However, chemical processes can be highly corrosive to the strainers used. Typical strainers constructed of carbon steel or even stainless steel can quickly deteriorate when exposed to corrosive chemical fluids for extended periods. For this reason, costly duplex stainless steel and super duplex stainless steel (with chromium content up to 25%) are often utilized for greater corrosion resistance. However, even with the added expense, virtually continuous exposure to chemical-laden fluids can still lead to corrosion issues.

In most applications with an oil-based solution, the material of construction of the strainer is decided based on the piping. If all the piping is carbon steel, a stainless-steel strainer is probably not needed. The internals are going to be made from stainless steel. The pressure vessel can be carbon steel, but processors may find that fiber-reinforced plastic (FRP) is preferable as a pressure vessel for their automatic strainers.

In fact, CPI facilities can save approximately half the cost or more when the strainer's intake vessels and piping are built with FRP, while only the internals are constructed with super duplex stainless steel.

FRP is a composite material made up of polymer supported with fibers for added strength. FRP is already widely utilized for the piping used to carry corrosive seawater for once-through process cooling at power plants. Due to the FRP's strength, the material can also be used to build to the standards of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (BPVC) Section X, which establishes requirements for the fabrication of FRP pressure vessels.

As a much more cost-effective alternative, seek out an original equipment manufacturer (OEM) that offers the option of using exceptionally corrosion-resistant FRP for external strainer construction, including the pressure vessel itself. The internal mechanism is still manufactured with

super duplex or similar steels.

There is no need to fear utilizing FRP for pressure vessels. FRP was initially employed for pressure vessels in 2007, and it continues to operate effectively. FRP has also been used for high-pressure applications reaching 300 psi (20 bars).

In the context of chemical process cooling, it is advisable to employ FRP for all piping within seawater intake systems due to its cost-effectiveness and the corrosive nature of seawater.

Since FRP is far more corrosion-resistant to chemical processes than carbon steel or stainless steel, yet costs just a fraction of expensive duplex or super duplex stainless steels, it is becoming a popular construction material for chemical process straining equipment.

Chemical process, cooling and wastewater-treatment conditions can change along with production schedules and the seasons, so it is important for companies to utilize technology that can flexibly and reliably meet compliance requirements and protect downstream equipment.

Automatic scraper strainers are designed to do so and can tolerate the inevitable surprises and variability, while also helping to minimize maintenance. Chemical processors that consult with an expert on automatic scraper strainer selection will benefit from greater process reliability and quality, as well as equipment longevity, at an economical cost. ■

Edited by Scott Jenkins

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All images within this article appear courtesy of Acme Engineering.

Author

Robert Presser is vice president of Acme Engineering Products, Inc. (Trimex Building, Route 11, P.O. Box 460 PMB 10, Mooers, NY 12958; Phone 518-236-5659; Email: rpresser@acmeprod.com; website: acmeprod.com), a North American manufacturer of industrial self-cleaning strainers. The company is an ISO 9001:2015 certified manufacturer of environmental controls and systems with integrated mechanical, electrical and electronic capabilities. Presser is the third generation of family management of the privately-owned company. He holds an MBA from the University of Western Ontario and a bachelor's degree from the University of Montreal. Presser is an experienced project manager, covering mechanical, electrical and electronic engineering disciplines for Acme's contracts with international engineering firms.

Advanced Strategies for Wastewater Management

Managing wastewater at chemical process industries (CPI) facilities requires a tailored approach, and effective treatment promotes sustainable operations while avoiding potential regulatory penalties

Bryon Lawrence
Reworld Waste LLC

IN BRIEF

For many consumers and businesses, wastewater simply disappears down the drain and out of sight. However, for industrial producers of liquid waste — such as chemical manufacturing companies — wastewater requires careful consideration. This byproduct of the industrial process poses challenges and opportunities that demand both innovation and responsibility, making proper wastewater management a pivotal part of safe and sustainable operations.

Risks of improper treatment

Wastewater management is critical in the chemical process industries (CPI) because it ensures the safe and compliant disposal of liquid waste. Improperly managed wastewater poses significant risks of environmental pollution and legal repercussions (Figure 1). Regulatory violations can lead to penalties, legal actions and expensive cleanup costs. Managing these requirements demands substantial time and resources, involving investments in infrastructure, personnel and continuous monitoring, but is well worth the effort to avoid non-compliant situations. In water stressed areas, tailored solutions become even more vital to address these challenges effectively. Beyond financial and operational impacts, failing to manage wastewater responsibly can harm a company's reputation, affecting stakeholder trust and corporate social responsibility (CSR) commitments.

Advanced treatment methods

To effectively manage wastewater in the CPI, a combination of advanced treatment methods is essential to address various contaminants and ensure that the treated water meets regulatory standards for discharge or reuse. The sections below describe several key processes employed in advanced wastewater treatment.

Wastewater pretreatment. The initial step in the treatment process focuses on preparing wastewater for further treatment or discharge. This step includes pH adjustment, oil and water separation, flocculation, sedimentation and filtration. A pH adjustment ensures the wastewater's acidity or alkalinity is neutralized, preventing corrosion and enhancing subsequent treatment processes. Oil-and-water separation techniques, such as dissolved air flotation, remove oil and grease from wastewater. Flocculation involves adding chemicals to clump suspended particles together, making them easier to remove

FIGURE 1. Properly managing wastewater a CPI facility can reduce the risk of environmental pollution and legal repercussions

FIGURE 2. Managing wastewater in water-stressed regions presents unique challenges, but advanced treatment technologies can support water conservation

during sedimentation and filtration.

Screening and grit removal. Physical processes are used to remove large solids and organic matter from wastewater. Screening removes large debris, while grit removal eliminates heavy particles like sand and gravel. Sedimentation allows heavier solids to sink to the bottom, forming sludge that is later treated or disposed of, reducing the load on subsequent treatment stages and improving overall efficiency.

Biological treatment. Biological processes are used to remove dissolved and suspended organic matter. In activated sludge systems, microorganisms consume organic pollutants, converting them into biomass that settles out as sludge. Trickling filters, which use a bed of media for microorganisms to grow on, degrade organic matter as wastewater passes over them. These processes significantly reduce biochemical oxygen demand (BOD) and suspended solids.

Advanced purification. Further purification is achieved through advanced methods such as filtration, chemical precipitation, ion exchange and membrane processes like reverse osmosis. Filtration removes fine particles, while chemical precipitation targets specific contaminants for removal. Ion exchange and membrane processes provide high levels of purification, producing water suitable for reuse or discharge into sensitive environments.

Precipitation, flocculation and clarification. Precipitation involves adding chemicals to wastewater to form insoluble compounds that settle out as sludge. Flocculation enhances this process by aggregating fine particles into larger flocs, making them easier to remove. Clarification follows, where the flocs settle in a clarifier tank, leaving clear water for further treatment. These processes are effective in removing heavy metals, suspended solids and other contaminants from wastewater.

Liquid direct injection. Non-hazardous liquid materials undergo thermal treatment at a thermomechanical treatment facility (TTF). This method securely destroys a variety of liquid contaminants and is ideal for highly regulated industries, and those seeking alternatives to traditional wastewater treatment or solidification.

Product substitution. Advanced laboratory analytics play a significant role in identifying opportunities for wastewater reuse in other manufacturing processes. By substituting raw materials with more sustainable alternatives, companies can reduce the volume and toxicity of wastewater generated. This proactive approach minimizes waste at the source and supports circular economy principles.

Evaporation. Evaporation occurs when water in liquid waste is separated utilizing heat, leaving behind solid residues. The remaining solids can be composted, used as fuel, or used as energy-generation feedstock at a TTF. This process can be conducted through solar evaporation ponds or mechanical evaporators, depending on local conditions. Evaporation is particularly useful for reducing the volume of wastewater and concentrating contaminants for easier handling and disposal.

Water reuse in facilities. Water reuse is essential in industrial operations, especially for cooling processes and chemical dilution. Implementing water recycling systems helps conserve water resources and reduce the environmental footprint of manufacturing activities. Reused water can be treated to meet specific quality requirements, making it suitable for various industrial applications. For example, treated wastewater can be used for boiler feedwater, irrigation and even as a raw material in certain production processes.

Reuse in water-stressed areas

Managing wastewater in water-stressed regions presents unique challenges, but advanced treatment technologies can support water conservation and sustainable industrial operations (Figure 2). For example, locally generated wastewater can be tested and treated for reuse in various industrial processes. The treatment process involves comprehensive pre-treatment steps, such as pH adjustment, oil-water separation, flocculation, sedimentation, and filtration. Treated water can then be discharged to a publicly owned treatment works (POTW) facility for further treatment and reintegration into the natural water cycle.

TTFs can reuse reclaimed wastewater, as well as rainwater. These practices not only conserve precious natural resources but also set a model for what's possible in sustainable wastewater management. Collaboration with local industries and municipalities highlights how facilities can support water conservation efforts in regions facing significant water stress.

Determining the right solution

Selecting the appropriate wastewater treatment solution is crucial for ensuring efficient and compliant operations in the CPI. Several factors must be considered to tailor the treatment approach to specific needs and challenges. These factors are described in the following sections:

Material. Different materials require specific treatment methods. For example, chemicals and hazardous waste need specialized techniques to ensure safe disposal.

Volume. High-volume generators may prefer advanced wastewater treatment methods, while smaller volumes might be better managed

through evaporation.

Contaminant level. Varying levels of contamination necessitate different disposal methods to ensure complete treatment.

Regulations. Compliance with local, state, and federal regulations is critical, with some waste materials requiring adherence to multiple regulatory bodies.

Sustainability goals. Aligning treatment methods with sustainability goals, such as zero-landfill policies, can drive environmentally friendly practices.

Cost. Treatment costs vary based on material type, contamination level, and volume.

Credits. Utilizing environmentally friendly disposal methods may qualify for credits from regulatory bodies, reducing overall costs.

Future requirements. Ensuring the scalability of treatment solutions to meet future business needs is essential for long-term sustainability.

Selecting a wastewater partner

Choosing a reliable partner for wastewater management is crucial for ensuring operational efficiency and regulatory compliance. When selecting a liquid-waste solutions provider, it is important to evaluate several factors. First, assess the provider's capability to handle all waste disposal needs, including logistics and hazardous waste treatment. This ensures that the provider can manage the diverse waste streams that may be generated by your operations. Next, consider the provider's expertise and regulatory track record. A partner with extensive industry experience and a strong history of compliance will be better equipped to navigate the complex regulatory landscape and avoid potential legal issues.

Scalability is another critical factor; the provider should be able to manage your current waste volumes and accommodate future growth. This ensures that your wastewater management strategy remains effective as your business expands. Additionally, sustainability commitments are essential. Look for a provider that supports waste diversion, energy consumption reduction and other environmentally friendly practices. By aligning with a partner that prioritizes sustainability, your company can enhance its CSR efforts and reduce its overall environmental impact. Evaluating these factors thoroughly will help you select a wastewater treatment partner that can support your operational needs and long-term sustainability goals.

Sustainable practices

Effective wastewater management is essential for CPI professionals to ensure compliance, protect the environment, and maintain operational efficiency. To achieve the desired results, companies need to implement advanced treatment methods and tailored solutions and make sure they select the right treatment partners. These practices enable CPI facilities to achieve sustainable wastewater treatment and contribute to broader environmental goals. In today's complex regulatory, social and economic landscape, environmental stewardship is paramount. Adopting a sustainable waste management strategy can help your company maintain compliance and establish itself as an eco-conscious leader with all your important stakeholders. By exploring advanced wastewater management practices and understanding their implementation, your business can align with objectives that support both environmental and financial goals. ■

Edited by Scott Jenkins

Author

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Executive Interview: Covestro LLC

In this exclusive interview, Samir Hifri, Covestro's chairman and president, offers his perspective on the goals, challenges and accomplishments of the company, as well as the challenges faced by the chemical process industries

Samir Hifri joined Bayer, the predecessor to Covestro, as a management trainee in Pittsburgh, Pa. in 1998. He has since held various positions in North America, Europe and Asia, including global product manager in Germany, director of North American product management, commercial lead for Japan and Korea and head of the coatings and specialties business in Shanghai, China. Most recently, Hifri led the Covestro Hong Kong site as managing director and head of APAC Supply Chain & Logistics. Hifri holds a bachelor's degree in international finance from Duquesne University in Pittsburgh, Pa., and an executive degree from INSEAD in Fontainebleau, France.

EXECUTIVE INTERVIEW

How would you describe your company?

Covestro is one of the world's leading manufacturers of high-tech polymer materials. We like to say that you're never more than a few feet away from a Covestro product, although you may not realize it. We invented polyurethane and polycarbonate, and those beginnings still serve as the foundation for the thousands of variations of polycarbonate products and raw materials for polyurethanes, coatings and adhesives that we produce today. We have spent decades refining the chemistries, exploring applications and working with our customers to tailor our materials to their precise needs. Today, the products our customers create using Covestro materials are critical parts of peoples' lives, from electric vehicles (EVs), smartphone components, energy-efficient homes and businesses, sports and leisure applications, to some critical healthcare applications.

What goals are you trying to achieve?

First and foremost, we aim to keep our customers at the center of everything we do. Ensuring their success directly impacts our own success. That will never change. What has changed, however, is that we are looking at our business through a telephoto lens, focused on the future.

That future is one where Covestro's business embraces the circular economy and has a fully circular business model. It is a very ambitious vision, but one that we have concrete steps in place to achieve. To do so, we have set a mid-term goal to be operationally climate neutral, that is for our Scope 1 and Scope 2 emissions, by 2035. Longer term, we aim to be climate neutral for Scope 3 by 2050.

Bringing that logic back to our customers, it means that they will have access to more sustainably produced raw materials from Covestro, which will directly support their own sustainability goals. One of our major U.S. customers recently said, "There is no downstream decarbonization without upstream decarbonization." As a company with a value chain position further upstream, we take this responsibility very seriously — so much so that we have developed a new portfolio of "circular intelligence" or CQ products. We already have hundreds of products in that portfolio, and we aim to have every one of our products available in a CQ version, which means they incorporate at least 25% alternative, non-fossil raw materials.

What challenges does your company face?

What is unique about our current business environment is that we're dealing with multiple issues simultaneously. From lingering inflation around the world to ongoing conflicts in Europe and the Middle East, to lingering supply chain interruptions, any one of these topics would pose challenges in a normal business climate. Additionally, Covestro is headquartered in Germany, and subsequently we have felt an acute impact from increased energy prices, which still remain at a higher level.

From my position sitting in the U.S., however, this presents opportunities to leverage Covestro's strong global footprint to offset some of the challenges felt in Europe. I strongly believe that the U.S. in particular is primed for innovation — specifically, sustainable innovation. We have already been able to leverage incentives made available by the government for a major decarbonization project at our biggest production facility in North America, located in Baytown, Texas. We also see other opportunities for major sustainable investments in the near future. More broadly, I believe this speaks volumes about the benefits of collaborating with government on shared decarbonization goals.

The U.S. market is of major consequence for Covestro. The U.S. remains a hot spot for innovation across many industries where our customers play an active role. The combination of abundant and low-cost energy, innovation and proximity to our largest and most forward-thinking customers, as well as strong commitment from government to boost domestic manufacturing present Covestro with unique opportunities for strengthening our global performance.

What challenges do you see for the chemical process industries as a whole?

While working with the government to achieve shared goals around sustainability is important, the other side of the coin is an expanding, and in some cases, overreaching regulatory environment that is causing uncertainty throughout the chemical industry.

It is important to remember that the business of chemistry touches almost every other industry. Without it, there is no modern life, and cer-

tainly no sustainable future. As such, there is a fundamental disconnect between the goals set forth both by the government and by private companies alike, and the environment in which those goals are to be achieved. A prime example of this are the ambitious targets for EV adoption and the near simultaneous introduction of regulatory proposals that have the potential to prohibit the production of the very materials critical to producing EV battery housings and charging stations.

The chemical industry requires a level of certainty to operate efficiently. Assets and production infrastructure are long-term investments, often times with a relatively long timeframe for return on those investments. A regulatory environment that changes every few years creates a level of uncertainty that impedes innovation at best and shutters businesses at worst.

The silver lining, as I mentioned already, is that the shared goals for a sustainable future are only made possible through the business of chemistry. And, industry has a seat at the table. There is a path ahead that, while it may look different than business-as-usual has in the past, is one that industry can walk with other stakeholders from government, non-governmental organizations (NGOs) and others. Renewable energy, made possible by the chemical industry, will also power the chemical industry. Alternative, non-fossil raw materials will be the source of the products that so many of us use every day. Innovative new recycling technologies will help us discover ways to reuse everything from cars to mattresses. The future is bright, and chemistry is at the center of it.

What accomplishments are you most excited about?

I am incredibly proud of the progress our colleagues have made towards our journey of becoming fully circular. Despite the challenges we face externally, we are controlling how we play and are taking concrete steps towards our vision. Here in the U.S. specifically, in the last year alone, we managed to achieve some major milestones.

At our Baytown, Texas and Newark, Ohio sites, we received International Sustainability and Carbon Certification (ISCC) PLUS. This milestone gives Covestro ISCC PLUS certification in each of its major regions globally and is a critical component in the production of our CQ product portfolio. Using our existing infrastructure, we are now able to track sustainably attributed raw materials throughout our production process. This enables us to supply more customers across the U.S. and around the world with more sustainably produced products.

We also recently announced our Scope 3 emissions targets. This builds on our previously announced Scope 1 and Scope 2 targets, which were for operational climate neutrality by 2035. Now, we aim to be completely climate neutral by 2050. We have a concrete plan in place to achieve this ambitious target, which will require a transformation of our entire supply chain, working with our suppliers and customers to be more sustainable, as well as a focused approach on how we produce our own products and run our sustainability projects.

None of these goals would be possible without the support and engagement of our employees and the communities where we operate, which is why I am immensely proud of how Covestro employees across the U.S. consistently give back through volunteerism, financial contributions and incorporating themselves into the fabric of their communities. Covestro employees are committed to their communities and the company, and their passion will drive our future success as an organization. ■

Department Manager: Dorothy Lozowski

Company: Covestro
Number of Employees: Approximately 17,500
Corporate Headquarters: Leverkusen, Germany
Locations: 48 production sites worldwide
Leadership: Markus Steilemann, CEO
Main Products: Polymer materials
Website: www.covestro.com

Sliding Vane Pumps

Sliding vane pumps offer a potent processing option for low-viscosity liquids

Chris Hordyk
Blackmer

IN BRIEF

Multiple industries rely on process pumps for handling a variety of substances that help the world function as it does today. Those substances come in a wide variety of forms, from very thick materials like asphalt and adhesives to thinner liquids like acetone and water.

Low-viscosity solvents, such as acetone, benzene, ethanol, glycerin, hexane, methanol, toluene and water present several challenges to process pumps. Not all pumps can handle thin liquids well, which can lead to process-performance and efficiency problems. One of the primary concerns is keeping solvents contained within the pump and the associated systems. Some solvents pose health risks, especially with long-term exposure, making containment essential for safety. Solvents can also be expensive, meaning that operations cannot afford leakage — even in small amounts. Operators must also find a way to avoid wasting product that could be left over in the pump and transfer lines. If there isn't a way to retrieve and salvage a solvent, it must be flushed out and the material is lost altogether. Line-stripping becomes a key feature that operators need from their equipment when processing and transferring solvents. Without it, they also run the risk of product contamination if they are processing more than one solvent through the same pump.

Another challenge is the low lubricity on top of a solvent's low viscosity. Without lubricating properties, pumps that can't run dry will struggle and suffer when trying to process solvents. Running a solvent through a pump that requires lubrication means the internal components will sustain damage during the process cycle. Repeated processing will eventually lead to failure.

A variety of pump options are available for handling solvents. For example, one type that is often considered for handling low-viscosity liquids is the centrifugal pump. There is, however, another pump type that is very well suited for handling a variety of solvents and has several features that make it stand out as a choice for this task — the sliding vane pump (Figure 1). These pumps are designed with versatility in mind, making them an appropriate option for handling solvents. This article looks at sliding vane pumps and why they are one of the best-suited process technologies for solvents.

How sliding vane pumps work

Sliding vane pumps use a set of sliding vanes guided by a rotor inside the pump. When the rotor turns, the vanes slide in and out of their respective cavities. This motion creates variable chambers, allowing the liquid to flow into one chamber after the other. Each vane provides a positive mechanical push to the liquid in front of it. Once the liquid reaches the outlet, the pumping chamber compresses and discharges the liquid (Figure 2).

Vane contact with the chamber wall is maintained by three forces: centrifugal force from the rotor's rotation; push rods moving between opposing pairs of vanes; and liquid pressure entering through the vane grooves and acting on the rear of the vanes.

FIGURE 1. Sliding vane pumps are designed with versatility in mind, and are well-suited for handling solvents

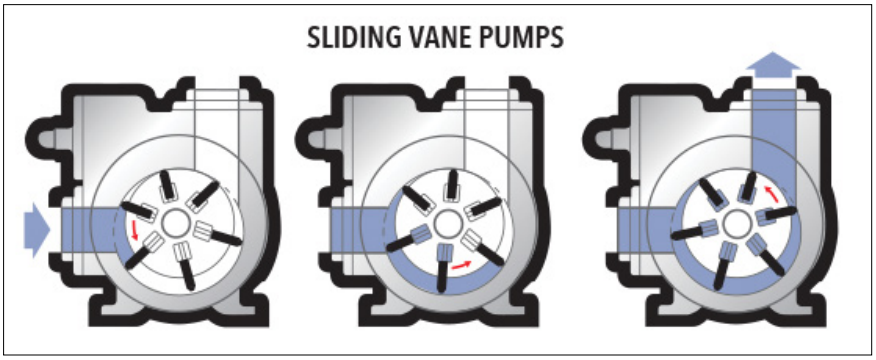

FIGURE 2. Sliding vane pumps use a set of sliding vanes guided by a rotor inside the pump. When the rotor turns, the vanes slide in and out of their respective cavities

Each revolution of a sliding vane pump displaces a constant volume of fluid. Variance in pressure has minimal effect. Energy-wasting turbulence and slippage are minimized, and high volumetric efficiency is maintained. Variances in pumping pressure have little effect on the sliding vane pump's flowrate, and the open-flow profile provides a gentle and low-shear environment within the pump.

Sliding vane pumps' operating principles allow them to offer volumetric consistency throughout their operational life, as well as the ability to handle a wide range of liquids, including ultra-thin liquids (0.2 cP) up to 22,500 cP, without compromising their performance.

Tight seals for solvents

Many pumps struggle with solvents due to the fact that they are thin liquids with low viscosities and will find leak points easily. Most of the time, those leak points occur around or near a pump's mechanical seals.

Sliding vane pumps combat leak points with their design, offering few, if any, areas for solvents to seep through. The magnetic-coupled model, for example, offers zero shaft leakage, meaning even the most hazardous solvents will be contained within the chambers of the pump.

Even if a sliding vane pump experiences a leak, likely from a seal or O-ring, those components are easily replaceable without taking the pump offline. The sliding vane pump's design allows for quick access, removal and replacement of those components.

Dynamic seals aren't an issue for the seal-less version of the sliding vane pump. This variety offers even fewer leak points, creating a safe environment for operators processing or mixing dangerous solvents. It also means one less wear part to worry about.

Lubrication not needed

Several processing pumps require a self-lubricating fluid to handle substances like solvents, which have low lubricity. Those pumps will suffer premature component wear and eventual failure if they repeatedly run those types of liquids through them.

Sliding vane pumps, meanwhile, don't have metal-on-metal contact, which allows them to run dry, meaning processing liquids with or without lubricating properties isn't an issue. Being able to run dry also means sliding vane pumps don't suffer from galling or related effects that impact pump life.

No waste product allowed

While sliding vane pumps aren't the only pumps that can process solvents, some pumps run into the problem of full product extraction. Some pump technologies require flushing the pump out — sometimes with an expensive cleaning chemical — before running a different solvent or other material through the pump.

Sliding vane pumps, however, are ideal at product recovery. Because sliding vane pumps can run dry without detrimental effects, operators can line-strip solvents from the pump, ensuring that the costly material being pumped doesn't go to waste. This affects more than just the pump. Sliding vane pumps can start empty and still draw a vacuum. This suction force not only clears out product from the pump but also from piping and hoses. The suction lift capability of sliding vane pumps exceeds 25 ft (8.3 m).

These features also allow sliding vane pumps to self-prime. After drawing a vacuum, the pump compresses air in the piping, pushes it through the discharge piping and then draws liquid from the suction source. This process occurs until the pump is primed, all without damaging it.

Because of these features, operators don't have to worry about running an expensive cleaning chemical to clear out the pump, while also losing the contained material. Additionally, there are no concerns of the detriments that come from an accidental dry-run, because the pump is designed to operate in this capacity.

Thin-liquid processing

Thin-liquid processing is a specialty of sliding vane pumps. The sliding vanes are designed to self-adjust for wear to sustain flowrate. The edges of each vane that contact the pump's cylinder eventually wear out over time. But the vanes, held within the rotor, slide out as the edges wear, maintaining the same contact as a fresh variant. This means that over the years, even with expected wear on the vanes, the performance of the pump will not suffer because the vanes continue to maintain their contact as they did out of the box. The pump will function optimally over its lifetime, with the vanes ensuring volumetric consistency and preventing internal slip.

When the vanes eventually wear out, an operator can replace them seamlessly without removing the pump from the piping system, ensuring less downtime for the pump. The vanes, along with other wear parts on sliding vane pumps, are easily replaced, allowing operators to enjoy shorter maintenance periods and longer times between intervals.

The low-viscosity nature of solvents plays well in sliding vane pumps, especially given their viscosity range. Along with viscosity flexibility (0.2 to 22,500 cP), sliding vane pumps also have pressure flexibility, handling pressures up to 100 psi (6.9 bars) without sensitivity to a narrow best efficiency point (BEP) common to centrifugal pump designs.

Additionally, this technology is effective with liquid variances as well. From ultra-thin liquids to fluids with suspended solids, to those with seasonal viscosity to vapors, sliding vane pumps are versatile when it comes to the substances they can process.

Additional benefits and features

Functionality is a key attribute for sliding vane pumps. Some pump technologies operate optimally at a specific performance point. Because of a sliding vane pump's wide and consistent flow range, the technology doesn't have to reach a particular point to run at its best; it is always at its BEP.

Other pump technologies struggle to reach this point when certain conditions occur, such as extreme weather, but sliding vane pumps always achieve this peak efficiency regardless of the changes in their operating environment.

Sliding vane pumps also function in conditions that would hurt similar pump technologies, such as continuous cavitation in low net positive suction head (NPSH) applications. This functionality plays a key role in solvent processing as vapor pressure — high or low — proves troublesome for other processing pumps.

For example, higher vapor pressure will cause other pump technologies to consume more energy as they process solvents. Sliding vane pumps often handle multi-phase vapor/liquid mixtures well because the flowrate isn't as harsh as it is in comparable pumps.

The design of sliding vane pumps also assists with component life. These pumps have a between-the-bearing support design, meaning the rotor is supported equally on both sides, resulting in minimal shaft deflection and the prevention of cyclical deflection and fatigue. The sealing surfaces are also immediately adjacent to the bearings, making them stationary and ensuring longer seal life. The ultimate benefit of the between-the-bearing design is that no uneven loads occur, which means even wearing of all components. ■

Edited by Dorothy Lozowski

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All pictures are supplied courtesy of Blackmer

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A Primer on LPG Storage Systems

Any loss of containment for liquefied petroleum gas (LPG) can have potentially catastrophic results. This article details various LPG storage configurations with special focus on the design of mounded-bullet systems

Koya Venkata Reddy
FACT Engineering and Design Organization (FEDO)

Liquefied petroleum gas (LPG) is a mixture of propane and butane, normally found in the ratio of about 60% propane to 40% butane. It is used primarily as a fuel for cooking, industrial systems, auxiliary/backup power systems and other applications. Storage of LPG is a prime concern in petroleum refineries and logistics terminals (Figure 1), because any accidental leak can lead to catastrophic explosions, likely resulting in a boiling-liquid expanding-vapor-cloud explosion (BLEVE).

It should always be borne in mind that even though LPG is transported and stored as liquid for economy and convenience, it is a gas when liberated at normal atmospheric temperature and pressure, and in case of emergency, it should be treated as gas and not as liquid. This article provides some guidance in LPG storage best practices to help avoid unsafe scenarios.

LPG handling areas

Any area where LPG is handled should follow stringent safety practices. Below are some of the common facility types and handling areas where LPG might be encountered.

Petroleum refineries. Propane and butane are commonly produced in crude distillation columns and transferred to large-capacity storage tanks for loading into ships and trucks at export terminals. These storage tanks are typically the mounded-bullet type, which are discussed at length in this article.

LPG import terminals. Propane and butane imported in large marine vessels are typically unloaded through marine loading arms and pumped to shore through pipelines and stored in mounded-bullet storage tanks separately. After heating the propane and butane using seawater flowing through titanium heat exchangers, the propane and butane are then mixed at the required proportions to match customer specifications. The hot seawater is sent back to sea.

Marketing terminal. The LPG received at marketing terminals, either from a petroleum refinery or import terminal, is distributed via pipelines to LPG bottling plants, from which it is subsequently distributed to a municipal gas-distribution system or through cylinders.

LPG bottling plants. LPG bottling plants are located at strategic locations to receive LPG in moderate quantities at mounded bullets and are filled in cylinders using carousels and belt conveyors.

FIGURE 1. Large volumes of LPG are transported and stored within shipping and marketing terminals all over the globe

Storage options for LPG

There are three primary storage configurations for LPG, which are summarized in Table 1 and discussed further in the following sections.

Aboveground, ambient-temperature pressurized storage tanks. These tanks typically have cylindrical or spherical geometry (Figure 2). Aboveground, ambient-temperature storage is used for storing smaller volumes of LPG, in the range of around 5–100 metric tons (m.t.), whereas aboveground cryogenic storage is used for storing larger volumes of LPG — around 5,000 m.t. or above.

Aboveground, cylindrical atmospheric cryogenic storage. LPG is stored in these tanks at –45°C and a design pressure of atmospheric pressure plus 1,500 mm H_2O. However, the tank is operated at lower pressures of around 500 to 800 mm H_2O. Boil-off gases arise out of the

FIGURE 2. Spherical tanks are typically used for storing smaller volumes of LPG

FIGURE 3. Mounded bullets are covered with sand and pebbles to help protect them against damage due to sunlight, vandalism and fire

storage tank due to heat ingress from atmospheric temperature and material-enthalpy changes. These gases can be compressed by pressure boiloff or holding compressors and cooled using the Joule-Thomson effect. The gas can then reenter the tank, thus maintaining the tank at atmospheric pressure and cryogenic temperature.

There are two walls for each tank with an annular space of 800 mm. The outer tank has a domed roof and the inner tank has a deck suspended from the outer dome roof, which covers the inner tank at the top. Product is stored in the inner tank, and in the event of inner tank failure, the outer tank is also capable of storing the product. This tank configuration is known as a double-wall double-integrity tank.

The philosophy of storing LPG is the same as for ammonia, ethane, propylene and other gases, although these storage options will vary in terms of the tank's material of construction.

Mounded bullets. Mounded bullets are aboveground storage tanks for storing large amounts of LPG in horizontal cylindrical vessels, which are buried under sand, rubble and in between retaining walls. The inlet and outlet to these storage tanks are provided with remote-operated shut-off valves (ROSOVs) on the bullet-first body-isolation valve. This provides an intrinsically passive and safe environment and eliminates the possibility of BLEVE occurrence.

Large amounts of LPG are stored in these tanks because they are protected against sun radiation and fire engulfment, radiation from a fire in close proximity and acts of sabotage or vandalism [*1*]. The area of land required to locate a mounded system is minimal compared to conventional storage. These storage tanks are designed for temperatures ranging from –45 to 55°C. In some facilities, mounded bullets are stored in parallel (Figure 3) with capacity up to 12,000 m.t., with a maximum of six bullets in a mound.

Instrumentation

Normally, storage tanks are to be filled with LPG up to 85% volume only, with the remainder being vapor space. The storage tanks should be provided with a local pressure indicator (PI), temperature indicator (TI) and mechanical gauge for liquid level measurement. Servo gauge and radar-type level gauges can also be installed. All the pressure gauges should be fitted with excess-flow check valves (EFCV) to shut off the mounded bullet in case the PI is accidentally detached from the tank. Liquid level is indicated in the control room, and various interlocks are provided for low-level and high-level control to protect the mounded bullet. All instrument controls' local indication should be provided on the top of the mound and should also be repeated in the pump house and control room. Pressure transmitters must also be fitted with double isolation valves and excess-flow EFCVs to protect the facility from accidental release of LPG.

LPG detectors. A minimum of one LPG gas detector should be installed on each exposed portion of the vessel. However, if the nozzles are covered in a dome, each group should have at least two detectors [*1*].

Pressure relief valves

Pressure relief valves (PRVs) are provided for the mounded bullet to protect against overpressurization. The relief capacity of the combined PRVs is typically designed to be only one third of the relief capacity of a conventional aboveground LPG storage tank. This is the main advantage of the LPG mounded bullet. It also reduces the firefighting equipment sizing. The PRV is sized for 30% of the capacity required for an equivalent size of conventional aboveground vessel.

The discharge of the PRVs should be connected to a flare system wherever available. PRVs should also have lock-open (or car-seal open) isolation valves on both sides of the PRV. In the discharge line of the PRV, a weep hole should be provided to drain any water accumulation, such as from rain.

High venting from PRVs shall be

TABLE 1. TYPICAL STORAGE-TANK PARAMETERS

Storage type	Operating pressure	Operating temperature	Typical volume (approx.)
Aboveground ambient cylindrical/spherical	14.5 atm	Ambient to 65°C	100 metric tons (m.t.)
Aboveground cryogenic cylindrical	1 atm	–45°C	5,000–15,000 m.t.
Mounded bullets	14.5 to 22.4 atm	–45 to 55°C	200–2,000 m.t.

placed a minimum of 3 m above the top of the mound or an exposed nozzle, whichever is higher, for better dispersion of released or vented LPG. Normally, the pressure safety valve (PSV) discharge is to be routed to high vent in small-capacity installations or to an elevated flare located at a safe distance for larger-capacity installations.

There are two types of PRVs used to protect mounded bullets: spring-loaded and multi-port. Ordinary spring-loaded relief valves are very common in industry, and are governed by codes developed by the American Petroleum Institute (API; Washington, D.C.; www.api.org) (API 520, 521 and 526) for sizing and installation [*2*, *3*].

Multi-port relief valves are mounted on the dome of the bullet with only one nozzle opening on the bullet. They have a fixed capacity as specified by the vendor. After calculating the total relieving capacity required for the bullet, either for the fire case or blocked discharge and overpressurization case, whichever is governing, the total required capacity is divided by the capacity of each port and the number of ports to be lined up is calculated. The remaining ports are spares and can be lined up or taken for maintenance without dismantling the multi-port relief valve (Figure 4). This is the main advantage of multi-port relief valves over conventional types of spring-loaded relief valves.

FIGURE 4. Multi-port PRVs enable port maintenance without dismantling the entire valve assembly

Fabrication

Mounded bullets are fabricated by welding multiple sections of cylindrical portions together. Each cylindrical piece is in turn fabricated using steel plates (usually 2.5 m wide and 6 m long), which are bent and welded to form the cylindrical parts (Figure 5). The individual cylindrical pieces are brought together with the help of cranes and placed inside the retaining wall (Figure 6). The pieces are connected by radial welding, followed by 100% radiography, a type of non-destructive test (NDT) to inspect weld integrity. After a sand-blasting surface-preparation step, the surface is painted. The selection of plate dimensions depends on the principle of reducing the wastage of steel in the overall fabrication of mounded bullet. Low-temperature carbon steels (LTCS) are used as the material of construction for the bullet shell.

Benefits of mounded bullets

Because the LPG-containing bullets are covered with rubble and sand, the tank surfaces are not directly vulnerable to sun radiation or flame impingement [*1*].

As a result, the bullet wall, and subsequently, the LPG itself, will not heat up, meaning that vapor generation inside the bullet is controlled. Since the probability of vapor generation is decreased, the relief rates used for sizing relief valves can be assumed as 30% of the relief load of the normal bullet aboveground (without mounding). Substantial savings are gained because of this, due to the smaller PRV sizes and the lower

FIGURE 5. Mounded bullets are fabricated from carbon-steel plates. Cranes are used to pull the pieces together inside a retaining wall

FIGURE 6. Mounded bullets are placed inside a retaining wall prior to welding and radiography inspection

FIGURE 7. A pumphouse is an essential element for LPG storage installations. Typically, vertical-barrel pumps are the preferred pump option

load on the flare system, which necessitate a lower flare height and lower associated costs.

Other design considerations

Design of such pressure vessels is governed by industry codes ASME SEC. VIII Div. 1 or PD 5500 or equivalent, as duly approved by the appropriate authorities. A single code should be adopted for design, fabrication, inspection and testing of all mounded bullet tanks at a facility.

Sizing. The size of a mounded bullet is selected according to the volumetric capacity of LPG to be stored in the facility.

Siting and coverage. The site of a mounded bullet is selected based on soil-bearing capacity (SBC), soil settlement with LPG or water inside the bullet and other parameters like the length and diameter of the bullet. The mound is to be suitably covered and sloped so as to drain the rainwater so that bullet will not dismount and float, and subsoil surface water cannot enter the mound [*1*].

Cathodic protection. The mounded surface of bullets should be cathodically protected to prevent damage from corrosion.

Nozzles, flanges and manways. All nozzles on the bullet top should be approachable from the top of the mound. To avoid static electricity issues, flanges should be equipped with copper jumpers and piping should have an earthing-strip connection. Two manways must be provided on the mounded vessel for easy maintenance during decommissioning.

Pumping system. Normally, vertical barrel pumps are used for LPG service to increase the net positive suction head available NPSH(A) for better pumping and to avoid cavitation. Also, inlet/outlet valves are provided along with ROSOVs and must be failsafe and enclosed in fireproof box connected with fire-retardant cables. A pumphouse for an LPG storage installation is shown in Figure 7. ■

Edited by Mary Page Bailey

References

1. Oil Industry Safety Directorate (OISD), Standard 150, Design and Safety Requirements for Liquefied Petroleum Gas Mounded Storage Facility, Sept. 2021
2. API 520, Sizing, Selection and Installation of Pressure-Relieving Devices, Part II — Installation, 6th Ed., March 2015.
3. API 521, Pressure-Relieving and Depressuring Systems, 6th Ed., January 2014.
4. API 2000, Venting Atmospheric and Low-Pressure Storage Tanks, 7th Ed., March 2014.
5. API 2510, Design and Construction of LPG Installations, 9th Ed., August 2020.

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Unipetrol Enhances Operational Stability with Advanced Combustion Control

A heater assessment study at an olefins plant led to the implementation of a new combustion-control platform in several furnaces to help optimize fuel ratios, improve overall furnace stability, reduce emissions and extend asset lifespan

Kevin Finnan
Yokogawa

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Like many companies in the chemical process industries (CPI), Unipetrol has demonstrated an increased focus on environmental stewardship by minimizing the consumption of raw materials and energy. This focus led to the selection of a holistic combustion-control solution, the CombustionONE platform offered by Yokogawa Electric Corp. (Tokyo; www.yokogawa.com), to address multiple corporate goals, including increased efficiency, reduced emissions, enhanced operational stability and improved operational safety. With Unipetrol, Yokogawa executed a conceptual engineering assessment, which led to a heater assessment study on a furnace (Figure 1). This defined the scope and deliverables for a pilot project and provided a clear understanding of the platform's impact and return on investment (ROI). The pilot project ultimately led to a study of the entire olefins plant. After the successful pilot implementation, CombustionONE was deployed at three additional olefin furnaces. The remaining six olefin furnaces and a continuous catalyst regeneration (CCR) reformer in the refinery are in the process of implementing the platform in a subsequent phase, which is currently underway at the site.

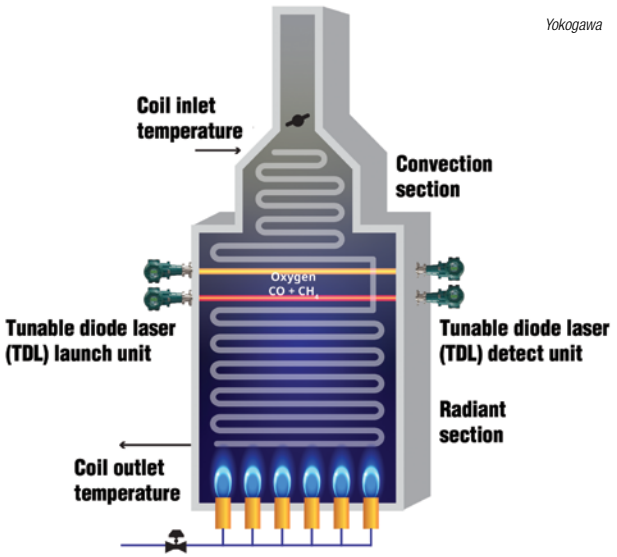

FIGURE 1. The CombustionONE control platform was used to support the optimization of fired heaters at Unipetrol's olefins plant. This resulted in improved yield, decreased coking and better control of fuel ratios, as well as other operational benefits

Tackling issues

Since the project involved multiple disciplines, Yokogawa was contracted to provide a turnkey solution. The core team has been responsible for the initial evaluation, detailed design and implementation of the technology platform. Although many fired assets appear to be similar, each has unique characteristics. Therefore, the CombustionONE platform can be tailored on a case-by-case basis to make the solution appropriate to any type of olefin furnace, even for units operating below 2% O_2 in the fluegas.

For Unipetrol, Yokogawa has provided a single point of contact to address all concerns and incorporate all requirements into the installed system. These include making accommodations for existing third-party equipment and services and incorporating the expertise from all stakeholders to maximize system performance while adhering to the plant operation schedule and milestones.

To ensure maintainability, the platform uses a Yokogawa logic solver that connects to the existing, third-party distributed control system (DCS). This allows annual fine-tuning and the addition of new features without impacting the base combustion controls. All functionalities inherent to CombustionONE can be implemented at any time and activated by operators without the need to restart the DCS. Once updates or improvements are installed, operators can seamlessly start or stop the CombustionONE application.

Impact evaluation

Tangible benefits have resulted from the stability of operation and increased efficiency at Unipetrol's

site, because the CombustionONE technology allows the furnace to safely operate closer to the carbon monoxide (CO) breakthrough point with no concerns about the air-fuel ratio becoming too fuel-rich. The combination of CO-overriding and cross-limit functionalities enhance the safety of operation with the ability to respond very quickly to any disturbances.

The pilot project benefited by having CombustionONE regulatory control logic, as well as advanced process control (APC) technology, which was implemented separately by Unipetrol's engineers. These complementary applications optimized process parameters, specific consumption and yield while enhancing safety.

Based on the training provided as a part of the deliverables, the actual operating standards were adjusted to better reflect the conditions as they varied during startup and the end of the run.

At the close of the project, performance tests were executed. Estimated fuel savings during the heater assessment study, in which a detailed thermodynamic model was created and validated for actual operational conditions, were compared with post-implementation results, and fell within 4% of predicted improvements. Considering influencing process aspects, such as the feedstock ratios in terms of C2, C3 and C4 concentrations, fuel composition and ambient conditions on furnace liberation duty and efficiency, the outcome for the complete olefin plant proved to be more than sufficiently reliable and trustworthy to justify additional projects.

Additional recognized benefits include the following:

- Increased throughput
- Improved stability concurrent with reduced crossover temperature
- Decreased coking deposits
- Improved asset lifespans resulting from reduced temperature swings
- Improved predictability of the propylene-ethylene ratio ■

Edited by Mary Page Bailey

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Kevin Finnan is a market intelligence and strategy advisor at Yokogawa Corp. of America (12530 W Airport Blvd, Sugar Land, TX 77478; www.yokogawa.com/us). Prior to Yokogawa, he was an independent consultant, as well as vice president of marketing for CSE-Semaphore and director of marketing at Bristol Babcock. He has over 30 years of experience in a variety of vertical markets and has launched more than 40 products in automation and measurement technologies.

Further reading

1. Process Control: Optimization at the Edge, *Chem. Eng.*, Feb. 2024, pp. 13–16.
2. Advanced Control Methods for Combustion, *Chem. Eng.*, Aug. 2014, pp. 34–39.
3. Facts at Your Fingertips: Industrial Combustion Products, *Chem. Eng.*, Mar. 2018, pp. 30.
4. Burner Technologies & Concepts: Meeting Emissions-Reduction Goals, *Chem. Eng.*, Sept. 2022, pp. 34–39.

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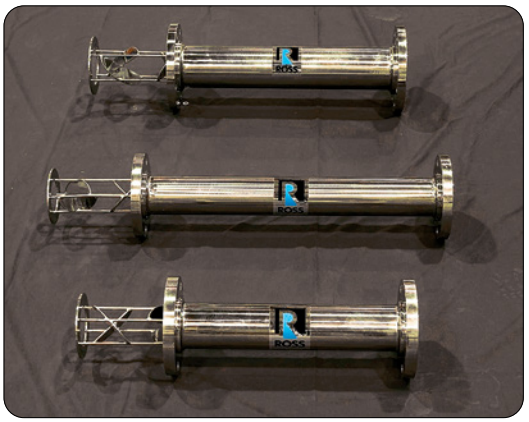
The LPD Static Mixer consists of a series of baffles or "elements" discriminately positioned in series. Each element comprises a pair of semi-elliptical plates set 90 degrees to each other. The next element is rotated 90 degrees about the central axis with respect to the previous baffle set, and so on. For even lower pressure drop, an LLPD model is also available, in which the plates of each element are oriented at 120 degrees relative to each other.

As the fluid moves through each LPD or LLPD element, flow is continuously split into layers and rotated in alternating clockwise and counterclockwise directions. This method of subdividing the stream and generating striations leads to highly efficient and repeatable mixing with minimal pressure loss. During turbulent flow, the baffles enhance the random motion of molecules and the formation of eddies. In most water and wastewater processes, four or six elements are more than sufficient to completely disperse treatment chemicals and create a very uniform solution or suspension.



Small LPD/LLPD mixers of 1 in. through 2.5 in. in diameter are welded to a central rod, while larger elements are welded to four outside support rods for maximum rigidity and stability. Available in a wide range of sizes up to 48 in. in diameter, these mixers can be supplied as pipe inserts or as complete modules with housing and injection ports.

In addition to Static Mixers, Ross also manufactures High Shear Mixers and Multi-Shaft Mixers used in the production of water treatment chemicals. The company offers no-charge mixer testing services and an extensive trial/rental program.

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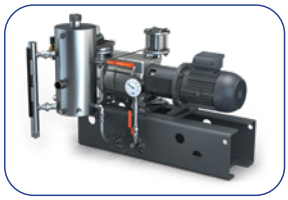
Sustainable Solutions for Chemical Process Wastewater

Choosing the Right Vacuum Equipment



Liquid ring vacuum pumps are widely used in chemical applications that have elevated vapor loads or those in which condensation in the vacuum pump tends to take place during the compression process. Fluid is used to create a seal between the inlet and discharge, typically water, which may make it more challenging to manage wastewater.

Innovative designs like those from Busch Vacuum Solutions DOLPHIN liquid ring vacuum pump series can mitigate these challenges. There are three primary methods for managing this fluid.

1. **Once-through system**: In some applications, the seal fluid is sent to a floor drain or treatment system after use. Often perceived as wasteful, this approach is preferred in scenarios with high particulate carryover, preventing potential product buildup
2. **Full recovery system**: Alternatively, the seal fluid can be recycled. It passes through a heat exchanger to remove compression heat and condensation, before returning to the pump. This method suits cleaner applications where continual disposal of contaminated water or solvents is impractical.
3. **Partial recovery system**: This configuration involves recycling a portion of warmer discharge seal fluid, mixing it with fresh fluid before reintroduction into the pump. It reduces fresh fluid demand, with manufacturers citing potential fluid savings of up to 50%, contingent upon vacuum level requirements and freshwater temperatures.

Choosing the right vacuum pump design hinges on application specifics like particulate carryover, solvent presence, and condensable vapors. Thoughtful design and control features can align with corporate energy and water initiatives, optimizing sustainability efforts.

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Electric actuators replace hydraulics

Retrofitting AUMA electric actuators eliminates oil leak risk

Retrofitting penstocks with AUMA electric actuators instead of previously installed hydraulics avoids any risk of contamination from oil leaking into the drinking water supply network of the city of Sydney, Australia.

An existing hydraulic actuation system was replaced with advanced electric actuators from AUMA at Potts Hill Outlet Works in Sydney. The actuators automate three large penstocks that are part of a major pipeline network operated by Sydney Water Corporation. The main reason for replacing hydraulic with electric actuation technology was concern that the hydraulic oil might leak and mix with the drinking water.

The AUMA actuators were delivered in the extra-robust STW version that is particularly suited to penstocks and other civil engineering works used in water applications. A key reason for choosing AUMA was Sydney Water's positive experience with AUMA actuators, which have been operating reliably for many years in other installations. Comprehensive data logging features future-proof these modern actuators for advanced diagnostics and predictive maintenance.

Sydney Water Corporation appreciated AUMA's comprehensive experience and services during the retrofit project.

The AUMA Retrofit Service helps operators find the most suitable electric actuation solution for their application requirements. Experienced AUMA experts take care of the entire project management: from a detailed analysis of the requirements, through the selection and sizing of suitable actuators from AUMA's broad actuator portfolio, to installation and commissioning on site by qualified AUMA staff.

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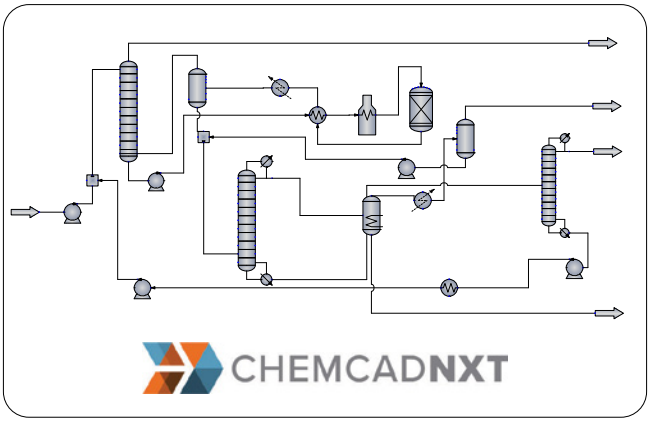

It's a tricky balancing act to meet regulatory pressures while the need for project viability and competitive advantage pushes engineers to prioritize cost savings.

One way to unlock potential cost savings is to optimize heat exchanger design to achieve project and operational cost objectives, while also supporting environmental goals.

Consider heat exchangers used in processes like industrial wastewater treatment. Wastewater has high fouling potential, yet fouling is detrimental to the efficiency of a heat exchanger. A process simulator like CHEMCAD, which has rigorous heat exchanger modeling capabilities, can calculate realistic fouling factors specific to the process. This information can then be used to calculate fouling rates and develop a predictive maintenance schedule, ensuring operational performance that can save you money.

Integrating the detailed heat exchanger design into the overall flowsheet further optimizes total process energy by leveraging broader process considerations. For instance, integrating waste heat recovery into the process can lead to significant energy cost reductions by transforming a waste stream into a valuable resource for pre-heating other process streams. The recovered heat boosts energy efficiency to meet both environmental and economic objectives.

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pH readings are also temperature compensated. The user can choose to perform a 1-, 2-, or 3-point calibration depending on the range of samples measured to achieve ±.01 pH accuracy. The pH sensor is of a proprietary construction and includes a large potassium chloride reference solution reservoir for long life. Myron L pH sensors are also user replaceable.

ORP measurements utilize a 99.9% pure platinum electrode and a reference junction that is shared with the pH sensor. Accuracy achieved is ±1 millivolt.

In addition, the 6PFC^E features a groundbreaking new way to determine Free Available Chlorine based on a predictive ORP value. Empirical measurements of the chemical activity of a solution are made without the hassle and subjectivity of colorimetric and test-strip methods.

Calibration and maintenance are simple, so the 6PFC^E can be serviced by the user. The 6PFC^E is also IP67 dust-tight and waterproof, NEMA 6 submersible, and buoyant. Plus, Myron L service and technical support are included for the life of the product.

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Chemical Treatment Helps Ensure Successful Wastewater Remediation

Beverage manufacturers are increasingly tasked with reclaiming and treating their effluent. As water gets more expensive and access to clean source water becomes more difficult, businesses can often struggle to meet stringent and ever-changing effluent standards.

Beverage makers can face harsh penalties, bad publicity and even mandatory shutdowns if they fall out of compliance.

A Brewery located near San Diego, CA prides itself on its commitment to environmental responsibility and sustainability, and the company sought to ensure it could produce an environmentally friendly product by adhering to strict wastewater remediation practices.

The biggest part of this commitment meant meeting state and county effluent standards. This required reclaiming all wastewater and treating it before discharging it into sewers. Breweries produce a lot of wastewater, averaging about 10 gallons of waste for every gallon of product.

Ultimately, the brewery chose to install a membrane bioreactor (MBR) followed by a reverse osmosis (RO) system. Accurate and Dependable Chemical Metering is critical to the entire system, so the company worked diligently to find metering pumps that would inject precise quantities of chemicals into the system. Since employees are not water treatment experts, it was also important to choose metering pumps that are easy to use and have minimal maintenance requirements.

The brewery purchased four Blue-White® FLEXFLO® A2 peristaltic chemical feed pumps. Two of the pumps are used to inject sodium hypochlorite into the MBR filter backwashes. The third pump injects sulfuric acid into the stream between the MBR and RO system. The fourth and final pump adds sodium hydroxide to the filtered effluent to raise the pH and avoid corroding public wastewater pipes.

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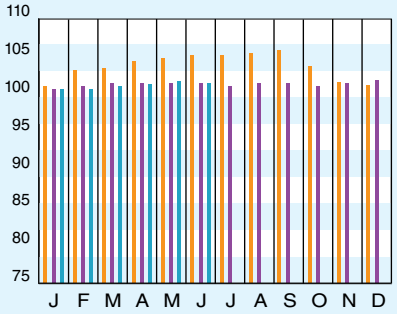
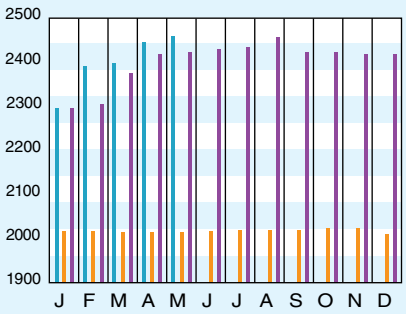
CPI output index (2017 = 100)	Jun. '24 = 101.1	May '24 = 100.4	Apr. '24 = 98.9	Jun. '23 = 99.7
CPI value of output, $ billions	May '24 = 2,421.2	Apr. '24 = 2,461.8	Mar. '24 = 2,445.6	May '23 = 2,319.6
CPI operating rate, %	Jun. '24 = 77.9	May '24 = 77.5	Apr. '24 = 76.4	Jun. '23 = 78.3
Producer prices, industrial chemicals (1982 = 100)	Jun. '24 = 298.7	May '24 = 299.5	Apr. '24 = 303.3	Jun. '23 = 318.1
Industrial Production in Manufacturing (2017 =100)*	Jun. '24 = 100.3	May '24 = 99.9	Apr. '24 = 98.9	Jun. '23 = 99.2
Hourly earnings index, chemical & allied products (1992 = 100)	May '24 = 229.2	Apr. '24 = 226.4	Mar. '24 = 227.0	May '23 = 219.0
Productivity index, chemicals & allied products (1992 = 100)	Jun. '24 = 93.0	May '24 = 92.5	Apr. '24 = 92.8	Jun. '23 = 93.6

2022 2023 2024

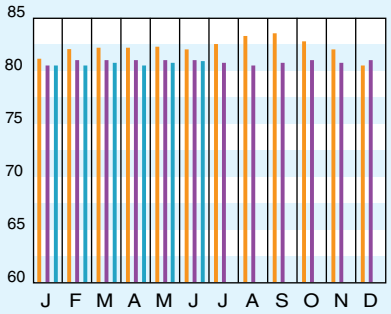
CPI OUTPUT INDEX (2017 = 100)†



CPI OUTPUT VALUE ($ BILLIONS)



CPI OPERATING RATE (%)



*Due to discontinuance, the Index of Industrial Activity has been replaced by the Industrial Production in Manufacturing index from the U.S. Federal Reserve Board.
†For the current month's CPI output index values, the base year was changed from 2012 to 2017
Current business indicators provided by S&P Global Market Intelligence, New York, N.Y.